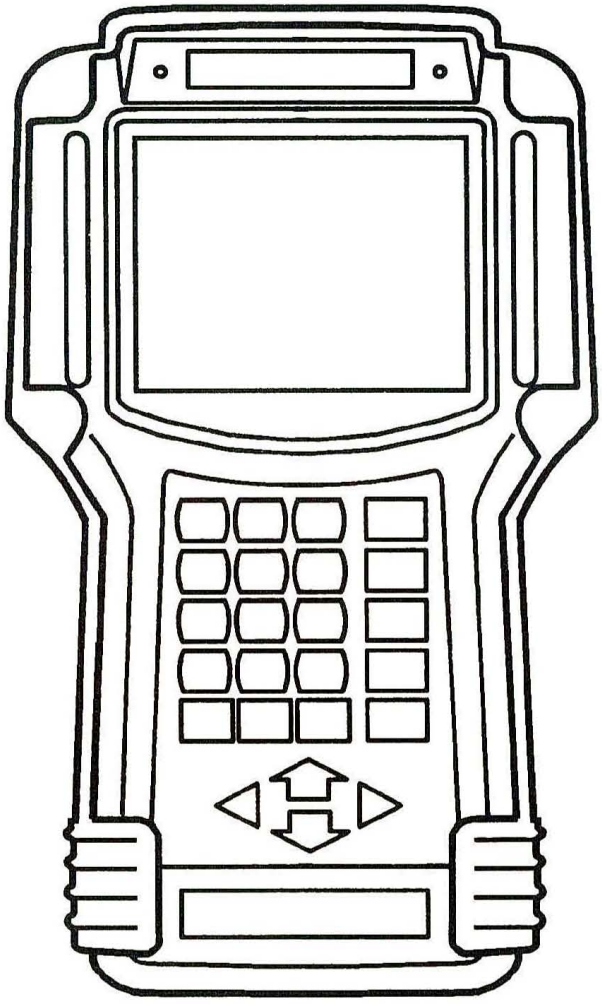
DCN PRO 2

User's Manual Vol.2: Tune-up Functions

Oscilloscope-Multimeter-Ignition Patern Analysis



Automotive Diagnostic Equipment Specialist
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OPERATING MANUAL OF DCN-PRO
FOR
OSCILLOSCOPE, MULTIMETER
AND
IGNITION PATTERN ANALYSIS FUNCTIONS

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Chapter 1. Oscilloscope

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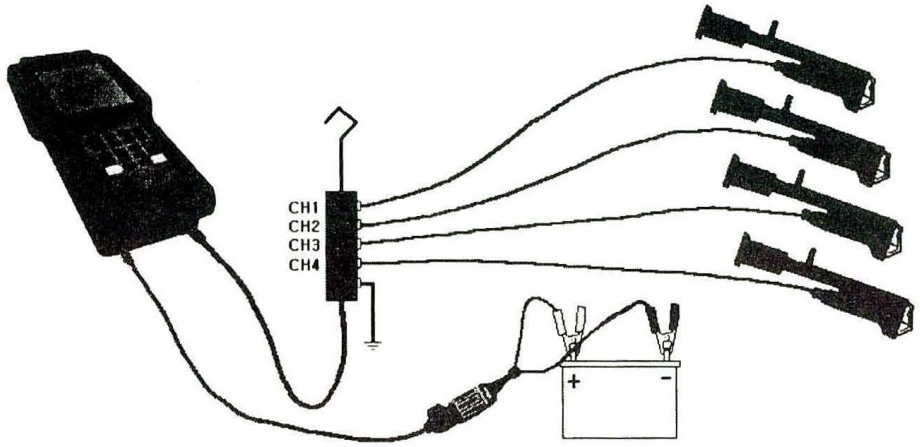
1. Introduction

A. Cable Connection for Oscilloscope



ILL. 3-1. Basic Cabling for 4-Channel Oscilloscope

B. Overview

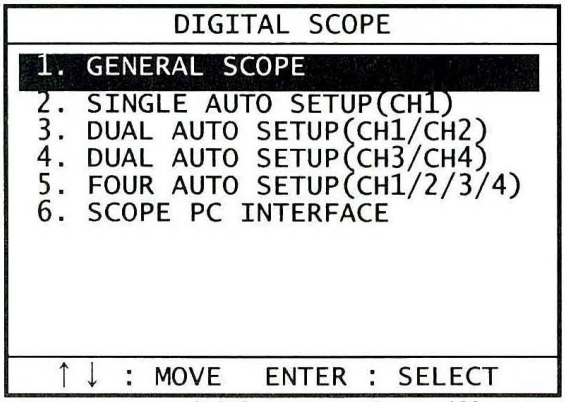
1) DCN PRO is the world's first scan tool with a 4-channel oscilloscope function. It can display up to four scope waveforms at a time.
The oscilloscope is not designed for R&D or research in labs, but for analysis of electric and electronic signals in automo tive circuits.

2) The Oscilloscope measures and displays DC voltage and up to 100㎑ of an AC signal.
   a. Time division : 25㎲ ~ 20s
   b. Voltage division 0.1V ~ 20V
   c. Auto Setup: Adjusts time and voltage divisions automatically according to the input signal
   d. Display freeze function
   e. Zoom : Up to ×5

2. Start Up

A. Channel Selection

Select the scope function from the main menu by pressing the [2] key. DCN PRO then displays the initial menu of oscilloscope function as in ILL. 3-2.


DIGITAL SCOPE
1. GENERAL SCOPE
2. SINGLE AUTO SETUP(CH1)
3. DUAL AUTO SETUP(CH1/CH2)
4. DUAL AUTO SETUP(CH3/CH4)
5. FOUR AUTO SETUP(CH1/2/3/4)
6. SCOPE PC INTERFACE
↑ ↓ : MOVE ENTER : SELECT
ILL. 3-2 Initial Menu of Oscilloscope

1) General Scope

No Auto Setup. User shall adjust the voltage and time divisions manually

2) Single Auto Setup(CH1)

Auto Setup for CH1 only. Displays the signal from CH1

3) Dual Auto Setup(CH1/CH2)

Auto Setup for CH1 and CH2. Displays the signal from CH1 and CH2 together

4) Dual Auto Setup(CH3/CH4)

Auto Setup for CH3 and CH4. Displays the signal from CH3 and CH4 together

5) Four Auto Setup(CH1/2/3/4)

Auto Setup for all four channels. Displays the signal from CH1 through CH4.

B. Sensor Selection

When you choose 2 through 5 from the above menu, the Auto Setup menu will follow. Since the voltage level and the output speed of the sensors vary from each other, you must choose the appropriate sensor.

CH1 AUTO SETUP	
1. INJECTOR	11. PRIMARY IG
2. A. F. S.	12. ALTERNATOR
3. O2 SENSOR	13. C. P. S.
4. ISC STEP MOTOR	14. 1 TDC SENSOR
5. ISC DUTY	15. PURGE SOLENOID
6. TR BASE	16. PASE SENSOR
7. T. P. S.	17. SENSOR (0-1V)
8. MAP SENSOR	18. SENSOR (0-5V)
9. V. S. S.	19. SENSOR (0-12V)
10. W. T. S.	
↑ ↓ : MOVE ENTER : SELECT	

ILL. 3-3 Initial Menu of Oscilloscope Function

According to the selected sensor, DCN PRO will adjust the proper Time and Voltage divisions, Trigger Level and Trigger Mode for the measurement and display of the selected sensor signal.

For example,

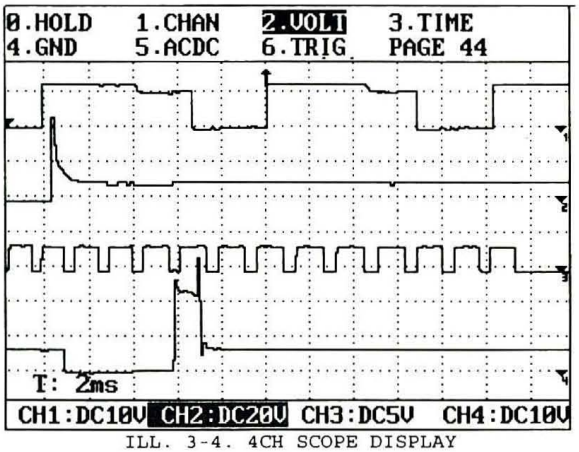
INJECTOR mode has its default setting as Volt Div:20V Time Div:1ms Trig Volt:5V Trig Mode: NORMAL

AIR FLOW SENSOR mode as Volt Div:2V Time Div:10ms Trig Volt:2V Trig Mode: NORMAL

If you chose Dual channel Auto Setup menu, the same menu for CH2 sensor selection will follow. For the four channels selection, CH2, CH3 and CH4 will follow up.

3. Display Format

When the Auto Setup selection is finished, DCN PRO begin to display scope output as shown below:

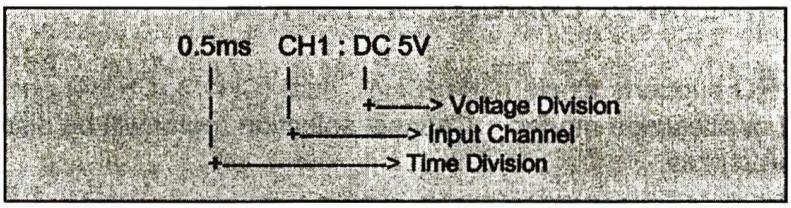


ILL. 3-4. 4CH SCOPE DISPLAY

1) Upper screen portion: Display control menu.
Details are explained in the following section.

2) Center screen: Oscilloscope Waveform display

3) Lower screen: Current set up status.
Details are as shown below.



4. Display Control

You can change the scope waveform display to your preference or purpose with the display control functions. The functions can be divided into two stages - NORMAL and HOLD, in other words, when [0. HOLD] is not selected and when it selected.

[0. HOLD] activates extensive functions for detailed analysis.

A. NORMAL: When [0. HOLD] is not selected

0. HOLD

[HOLD] MODE

- Stops displaying the Scope waveform and shows the detailed menu.

While in the [HOLD] Mode, the signal may be diagnosed in greater detail and other extensive display output control functions may be performed, i.e. Cursor, Trigger and Zoom.

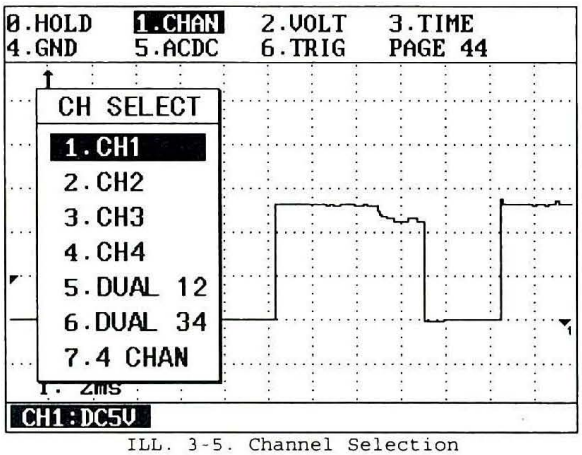
The details are explained in the following 'B. HOLD: When [0. HOLD] is selected' section.

1. CHAN

SIGNAL INPUT CHANNEL SELECTION

- DCN PRO supports single (CH1~CH4), dual (CH1/2, CH3/4) and four(CH1/2/3/4) channel oscilloscope modes. Channel selection menu will be displayed when you press the [1] key.

1~4. CH1~4: Signal Input from Channel 1~4. Single Channel
5. DUAL 12: Signal Input from Channel 1 and 2. Dual Channel.
6. DUAL 34: Signal Input from Channel 3 and 4. Dual Channel.
7. 4 CHAN: Signal Input from all Channels. Four Channel.



ILL. 3-5. Channel Selection

To select the input channel, move the highlight bar using the [▲] and [▼] keys and press the [ENTER] key.

2. VOLT

VOLT DIVISION ADJUSTMENT

- For Single Channel mode, the voltage division may be adjusted by using the [▲] and [▼] keys after pressing the [2] key.

- For Dual or Four Channel Mode, choose the input channel for which you wish to change the voltage division using the [◀] and [▶] keys or the [ENTER] key after pressing the [2] key. You will see the highlight move left and right in the bottom window. You can then change the voltage division by using the [▲] and [▼] keys.

- The voltage division alternates back and forth in the order of 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0, 20.0V as you press the [▲] and [▼] keys. These indicate the voltage per grid.

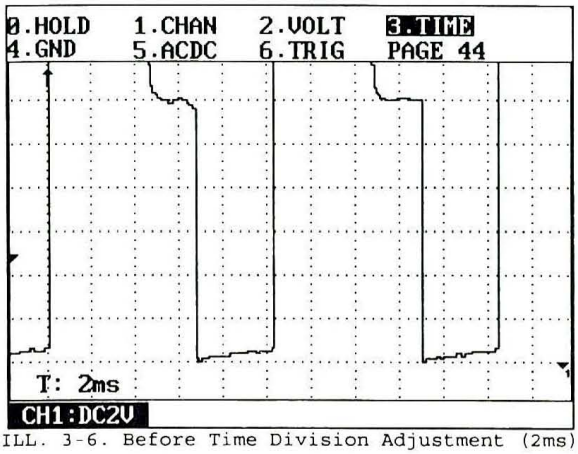
3. TIME

TIME DIVISION ADJUSTMENT

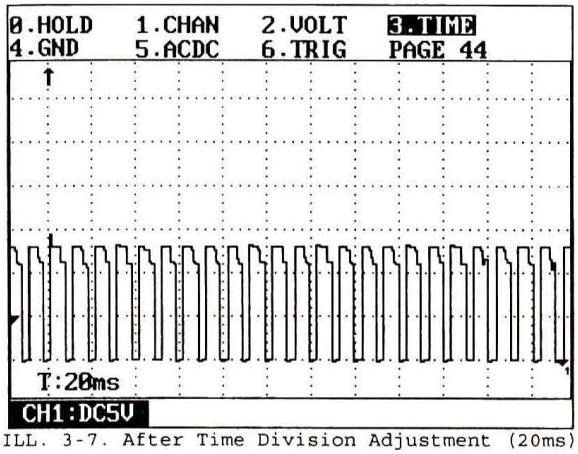
- Time division changes back and forth in the order of 25㎲, 50㎲, 0.1㎳, 0.2㎳, 0.5㎳, 1㎳, 2㎳, 5㎳, 10㎳, 20㎳, 50㎳, 0.1s, 0.2s, 0.5s, 1s, 2s, 5s, 10s, 20s per grid as pressing the [◀] and [▶] keys. Any duration longer than 0.1sec is called the

ROLL mode.

- For Dual and Four Channel mode, the time division of all channels will be changed together.



ILL. 3-6. Before Time Division Adjustment (2ms)



ILL. 3-7. After Time Division Adjustment (20ms)

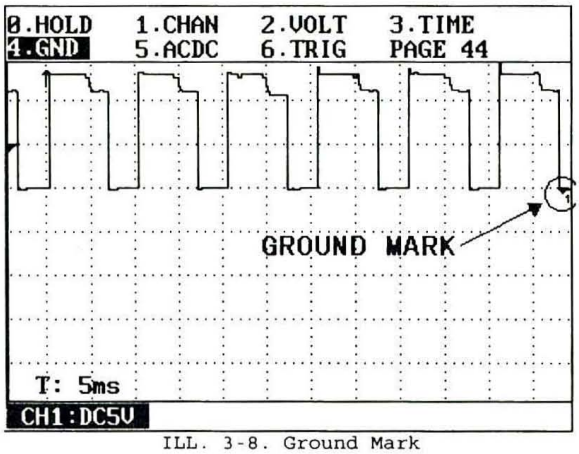
4. GND

GROUND LEVEL SHIFT

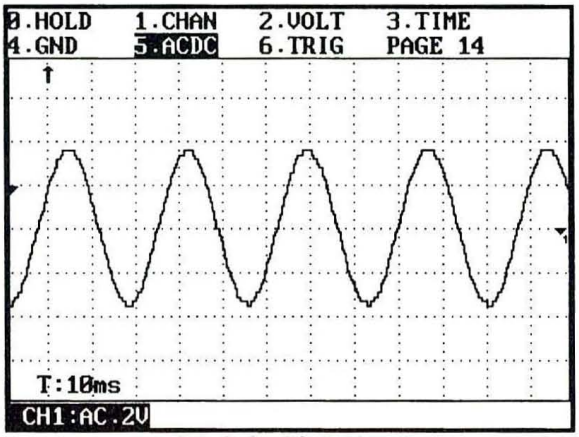
- The Ground Level may be moved up and down using the [▲] and [▼] keys.

- For Dual and Four Channel mode, the input channel that you wish to move the ground level must be chosen by using the [◀] and [▶] keys or by pressing the [ENTER] key after pressing the [3] key.

- On the right end of the display, the inverse triangle icon(▼) with a small digit next to it indicates the ground.



ILL. 3-8. Ground Mark



ILL.3-9. AC Pattern

5. ACDC

AC/DC VOLTAGE CONVERSION

- The AC and DC voltage scope modes can be switched when the [5] key is pressed. The default mode is DC voltage.

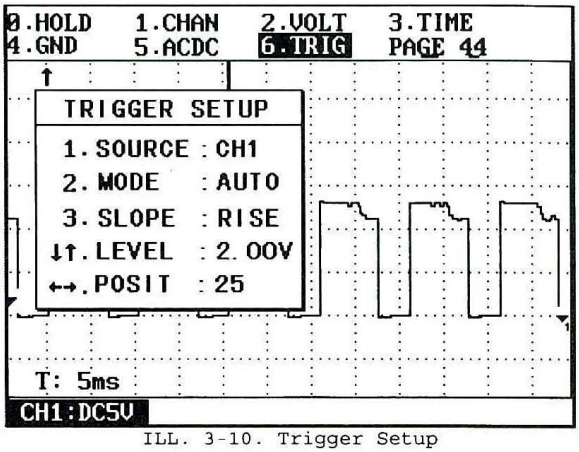
- The AC Voltage mode is used for measurement of Alternating Current signal such as Generator Waveforms (See ILL. 3-9)

- The current voltage mode is indicated at the bottom of display.

6. TRIG

TRIGGER SETUP

- When [6. TRIG] is selected by pressing the [6] key, the [Trigger Setup] menu will be displayed.



ILL. 3-10. Trigger Setup

1. SOURCE: Changes the Trigger Source in Dual or 4 Channel Mode

Repeatedly pressing the [1] key alternates CH1↔CH2 in Dual 1-2 mode, CH3↔ CH4 in Dual 3-4 mode, and CH1→CH2→CH3→CH4 in the Four Channel Mode.

2. MODE: Changes the Trigger Mode.

Repeatedly pressing the [2] key cycles between AUTO→NORMAL→SINGLE SHOT→AUTO mode.

AUTO	Auto Trigger - Continual display of waveform without trigger signal
NORMAL	Normal Trigger - No display waveform without trigger signal
SINGLE	Single shot Trigger - Stops displaying waveform when trigger signal is found, and proceeds to [HOLD] mode.

3. SLOPE: Rising / Falling Trigger Switch

The trigger voltage and its slope must first be determined. [3. SLOPE] decides which signal to catch as the trigger : rising or falling voltage as the trigger.

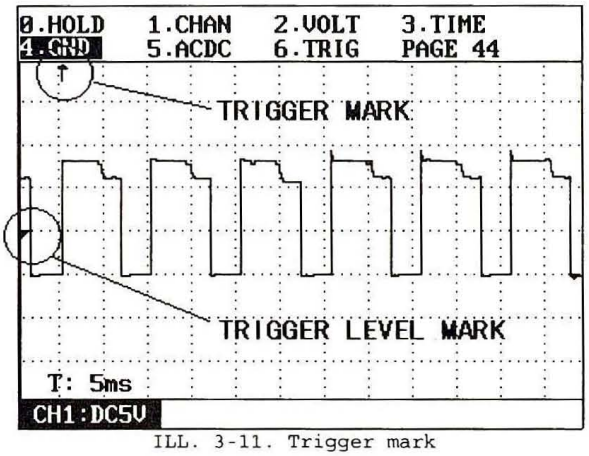
↑ ↓ LEVEL : Trigger Voltage Level

Adjust the trigger voltage level by using the [▲] and [▼] keys

The small triangle icon (◤ or ◣) on the left side of the display indicates the trigger voltage and slope(See ILL. 3-11)

⇔ POSIT : Trigger Position

Set the trigger position where you wish the triggered waveform to start. You can move the position horizontally using the [◀] and [▶] keys. The arrow mark (Rising : ↑ or Falling : ↓) in the top end of the display indicates the trigger position and the slope : Trigger Mark (See ILL. 3-11)



ILL. 3-11. Trigger mark

In Roll Mode (Time division longer than 0.1Sec), there is no trigger level mark and trigger mark shown in the display. It has no application in the Roll Mode.

PAGE ## : Number of saved pages

DCN PRO automatically records scope waveforms up to 50 frames to its

internal RAM(automatically deletes on exit).

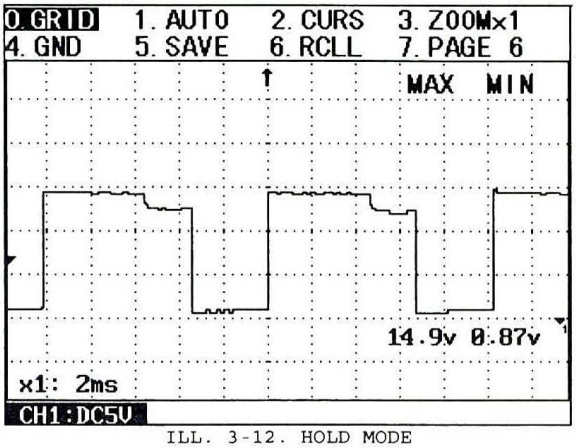
When [0. HOLD] is selected, waveforms can be saved to DCN's Flash ROM which can then be transmitted to your PC by using the PC Interface function.

ESC : Exit

B. HOLD: When [0. HOLD] is selected

[0.HOLD] stops waveform display and activates extensive functions for detailed analysis.

You will see that the menu on the top window is changed.

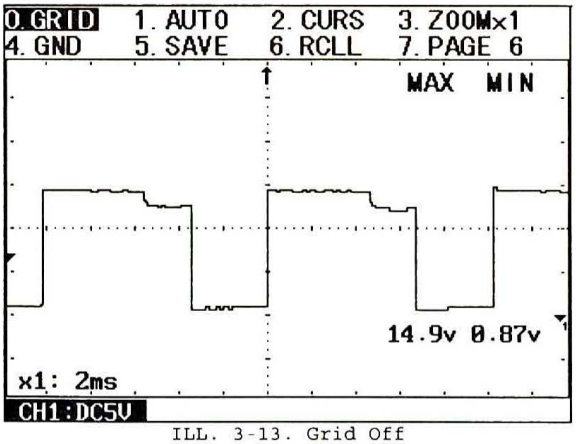


ILL. 3-12. HOLD MODE

0. GRID

Grid On / Off

Turns grid on / off



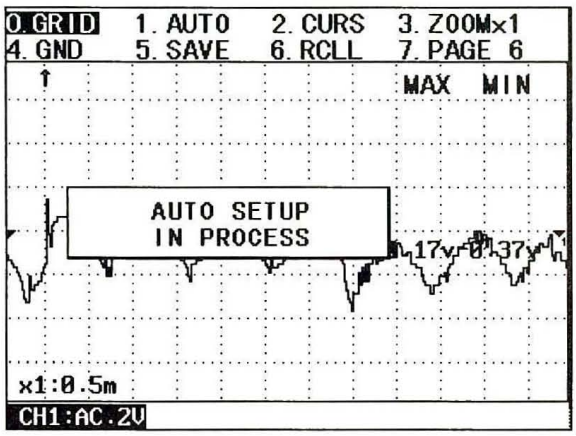
ILL. 3-13. Grid Off

1. AUTO

Auto Set-up

- Activates [Auto Set-up] function - sets up voltage division automatically in accordance with voltage input

- When the [1] key is pressed, DCN displays 'AUTO SETUP IN PROCESS' message, and then resumes the scope waveform display.



ILL. 3-14. Auto Setup in Process

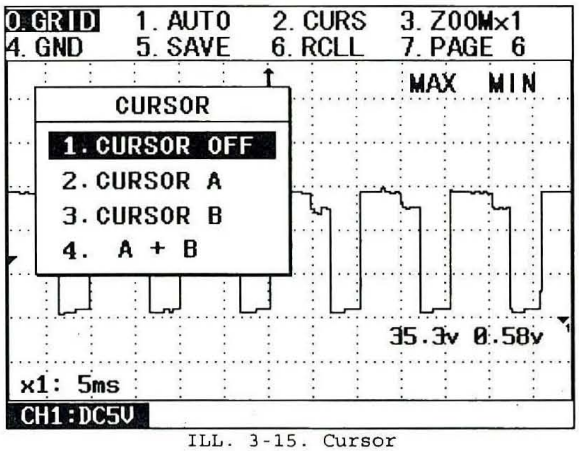
- In case of high input voltage levels such as Injector or Primary Ignition Patterns, above message may remain on the display. If this occurs, simply press the [ESC] key. The scope waveform display will resume.

1. CURS

Cursor

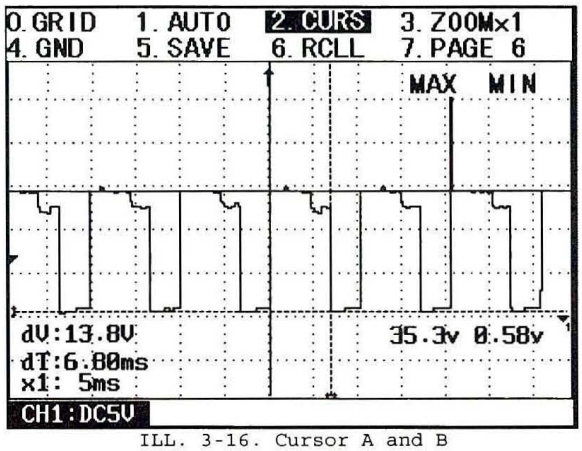
- Displays the cursor selection menu as shown in ILL. 3-15.

1. CURSOR OFF: Turns of the cursor(s)
2. CURSOR 1: Turns on and moves the solid line cursor
3. CURSOR 2: Turns on and moves the dotted line cursor
4. A + B: Turns on and moves both solid and dotted line cursors



ILL. 3-15. Cursor

- When you choose 2, 3 or 4, the cursor(s) will appear as shown below:



ILL. 3-16. Cursor A and B

dV : The voltage difference between the horizontal solid line and dotted line.
dT : The time gap between the vertical solid line and dotted line.
x1 : The time division per grid

- You can move the selected cursor lines using the arrow keys.
  ▲ / ▼ : Horizontal line up / down
  ◀ / ▶ : Vertical line left / right
  The line will move a pixel when you press the key once. Continually pressing the key will move the line in rapid succession.

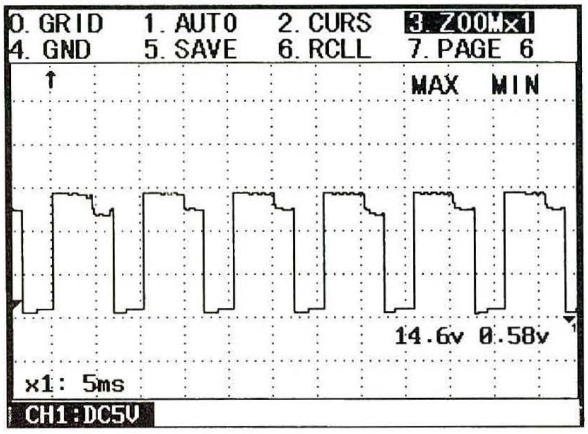
- In Dual or Four Channel Mode
  You can choose the input channel by using the [ENTER] key, and dT and dV value will be calculated based upon the time and voltage divisions of the selected input channel. The selected channel will be highlighted in the bottom window.

3. ZOOM

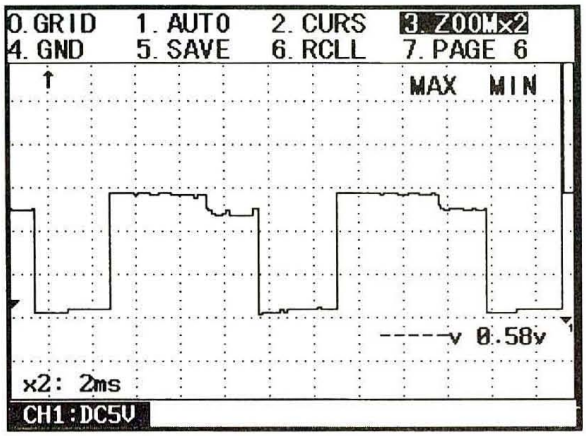
Waveform Zoom In / Out

- Zooms the scope waveform in/out in the horizontal axis. It has the same effect as reducing / increasing the time division value.

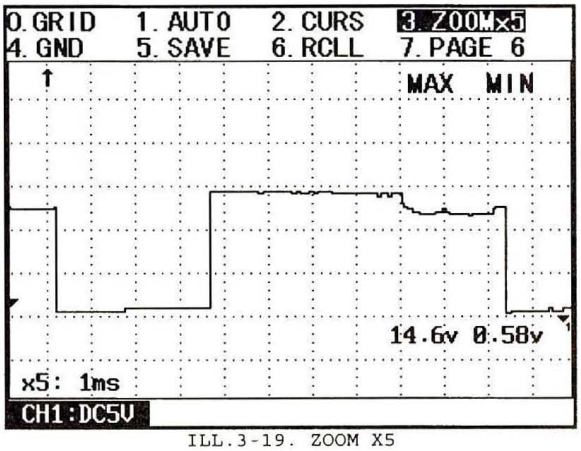
- The scale will alternate in increments of x1, x2 and x5 when you press the [3] key.



ILL. 3-17. ZOOM X1



ILL.3-18. ZOOM X2



ILL.3-19. ZOOM X5

DCN has a waveform data save / reload function. The following sections [5. SAVE] and [6. RECALL] will explain the procedures

- When recorded data is reloaded, press the [2] key. The recorded waveform can then be displayed frame by frame using the [▲] and [▼] keys. DCN records up to 12 frames per slot.

4. GND

Ground Shift

- Same as section 4.a [NORMAL: When [0.HOLD] not selected] part.

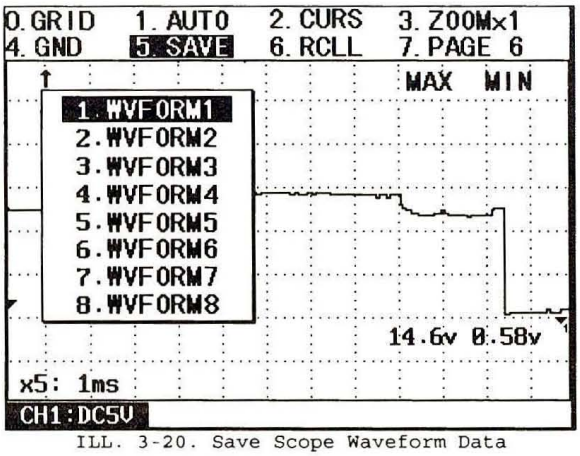
5. SAVE, 6. RECALL

Save waveform data / Recall saved waveform data

- As explained earlier, DCN PRO automatically records up to 50 frames of scope waveform data until [0. HOLD] is selected.

- If [5. SAVE] is selected, the Data Save Slot list will appear. Choose the slot by using the [▲] and [▼] keys and by pressing the [ENTER] key. Number keys may also be used. Used slots are marked '＊'.

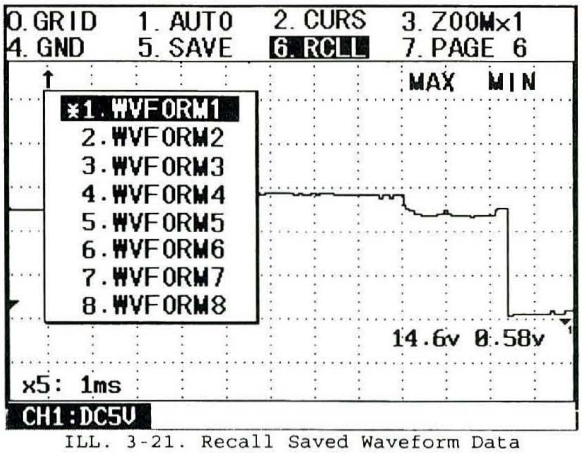
- If a used slot(marked by an '＊') is selected, any old data will be overwritten by new data.



ILL. 3-20. Save Scope Waveform Data

- The previously saved waveform data may be recalled by pressing the [6] key. The Save Data Slot list will appear. A slot marked by an '＊' indicates a slot containing data that may be loaded

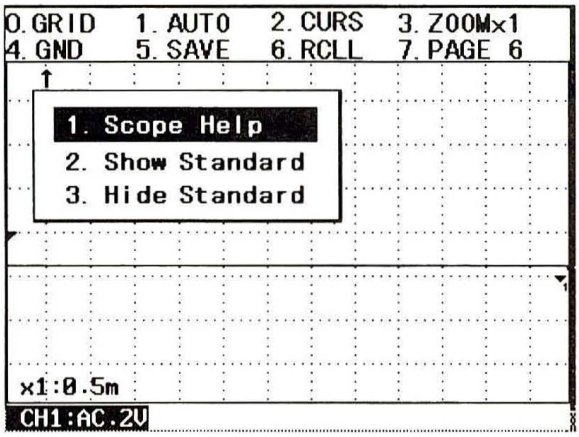
- If you want to delete the saved data, select the slot you wish to erase and press [ERASE] key.



ILL. 3-21. Recall Saved Waveform Data

C. Oscilloscope Help

When [HELP] is pressed during the scope waveform display, the help selection menu will appear as illustrated below:

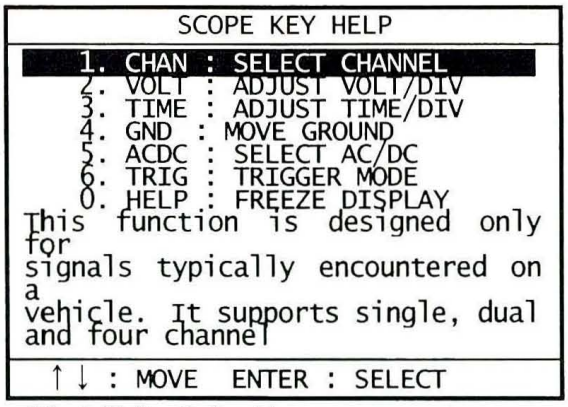


ILL.3-22. Oscilloscope Help Menu

1) Scope Help

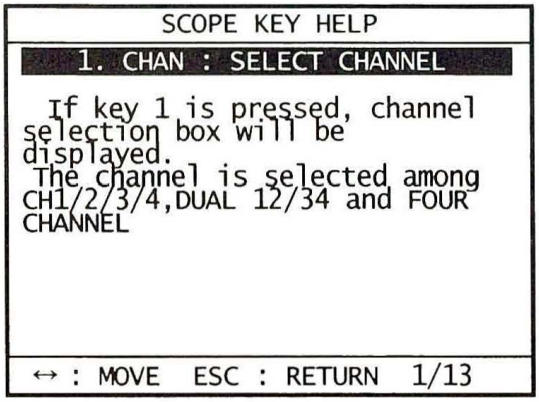
- Select [1. Scope Help] to view key explanations for the functions explained in this chapter. You will see the submenu as shown in ILL. 3-23.

The key explanation consists of 13 categories. They are as follows;
For NORMAL Mode : CHAN, VOLT, TIME, GND, ACDC, TRIG, HELP
For HOLD Mode : GRID, AUTO, CURS, ZOOM, SAVE, RCLL

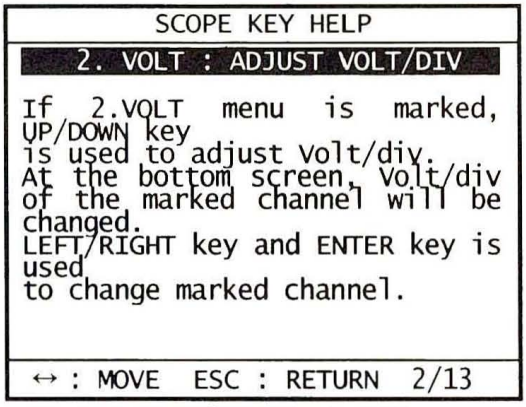

SCOPE KEY HELP
1. CHAN : SELECT CHANNEL
2. VOLT : ADJUST VOLT/DIV
3. TIME : ADJUST TIME/DIV
4. GND : MOVE GROUND
5. ACDC : SELECT AC/DC
6. TRIG : TRIGGER MODE
0. HELP : FREEZE DISPLAY
This function is designed only for
signals typically encountered on a
vehicle. It supports single, dual
and four channel
↑ ↓ : MOVE ENTER : SELECT

ILL. 3-23 Key Explanation - menu

- To view the detailed explanation for a key function, press the corresponding number or press the [ENTER] key after scrolling the highlighted bar to the desired object using [▲] and [▼] keys. Explanations for the selected functions will be displayed as in ILL. 3-24.


SCOPE KEY HELP
1. CHAN : SELECT CHANNEL
If key 1 is pressed, channel selection box will be displayed.
The channel is selected among CH1/2/3/4,DUAL 12/34 and FOUR CHANNEL
↔ : MOVE ESC : RETURN 1/13

ILL. 3-24 Key Explanation - 1. CHAN


SCOPE KEY HELP
2. VOLT : ADJUST VOLT/DIV
If 2.VOLT menu is marked, UP/DOWN key
is used to adjust Volt/div.
At the bottom screen, Volt/div of the marked channel will be changed.
LEFT/RIGHT key and ENTER key is used
to change marked channel.
↔ : MOVE ESC : RETURN 2/13

ILL. 3-25 Key Explanation - 2. VOLT

- The manual contents for other functions during the above display may be viewed using the [◀] and [▶] keys. Pressing the [ESC] key will bring you back to the upper menu.
  When you press the [▶] key from above display, the next key explanation will follow as in ILL. 3-25.

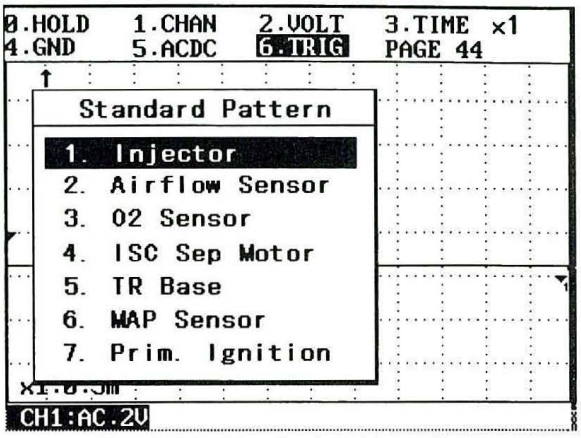
2) Show Standard (Pattern)

a. This function is designed for those new to the field of automotive sensor

analysis.

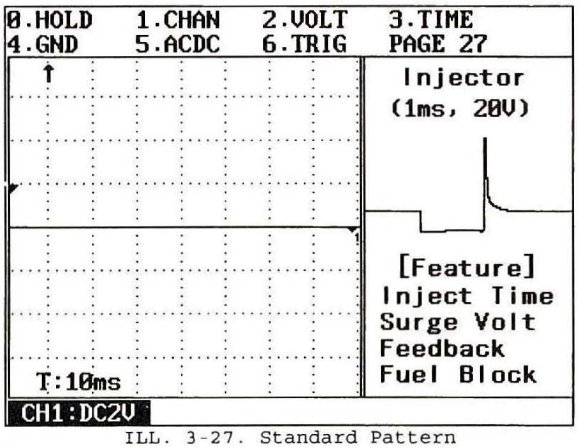
b. By showing the general patterns of sensor output, it provides the user with the proper voltage/time division and the key feature of each sensor and actuator.

c. Choose [2. Show Standard] from the scope help menu to view a standard pattern.



ILL.3-26. Standard Pattern Menu

d. Select a sensor/actuator from the menu. The standard pattern of the selected sensor/actuator will appear on the right side of the main window as shown in ILL. 3-26.



ILL. 3-27. Standard Pattern

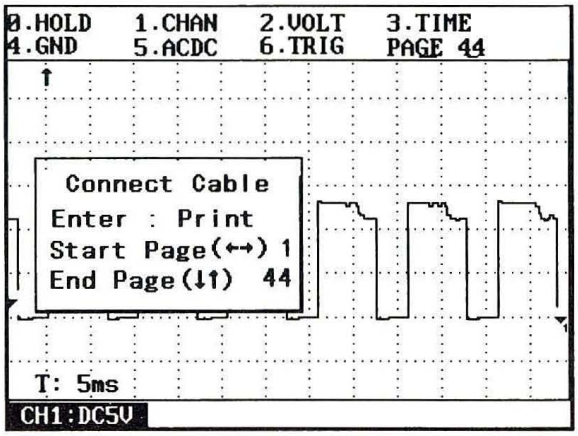
e. To hide the standard pattern, press the [HELP] key and then choose [3. Hide Standard].

5. Print Output

Prints the scope pattern. The current scope pattern display can be printed. The saved waveform data may also be printed by loading it from the memory slot.

A. Print current display

When you wish to print the scope pattern while testing the sensor/actuator with your DCN PRO, hold(freeze) the pattern display by pressing the [0] key first. Then press the [PRINT] key.



ILL. 3-28. Print Menu

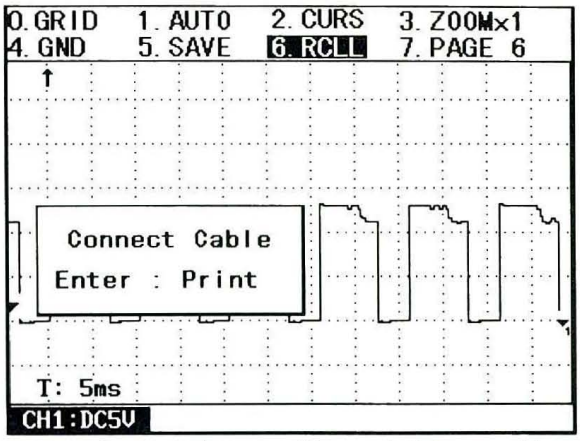
Since DCN PRO automatically records the scope patterns for up to 50 frames(pages) until you press the [0.HOLD] key, the page you wish to print must be selected as shown in ILL. 3-28. In the above example, the user selected to print all pages(1~44). You can change the start page with the [◀] and [▶] keys, and the end page with the [▲] and [▼].

When ready, press the [ENTER] key to print.

B. Print saved patterns

Load the saved waveform data from the memory slot : [0.HOLD] → [6.RCLL]

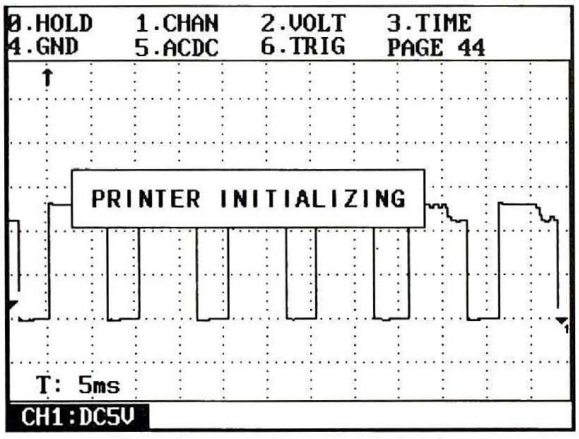
'Connect Cable' message will follow. The individual page cannot be set here. Since it is necessary to scroll back and forth to switch from frame to frame, only the current frame(page) may be printed at a time.



ILL. 3-29. Print recall saved data recall

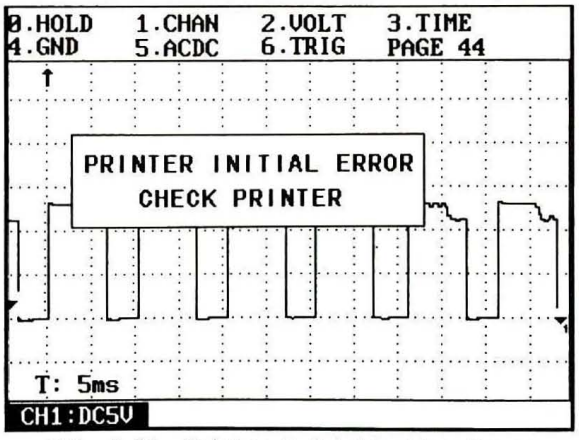
C. Print

DCN PRO initializes the printer when the [ENTER] key is pressed.



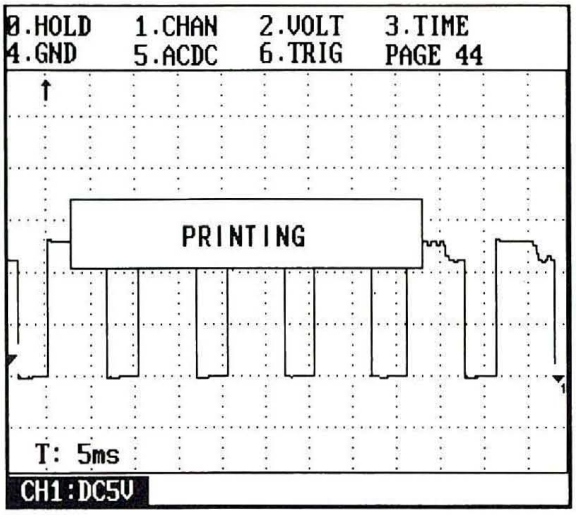
ILL. 3-30. Printer Initialize

If the printer initialization fails, an initialization error message will appear.



ILL. 3-31. Printer Initialization Error

If all conditions are OK, DCN PRO will begin printing.



Chapter 4. Multimeter

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2. Voltmeter 29

3. Duty Cycle 30

4. Frequency 32

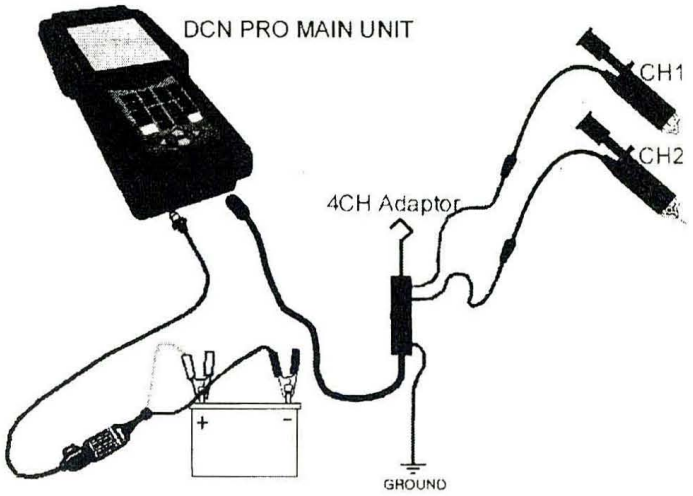
5. Show All – Volt Duty Freq 33

6. Battery Voltage / Current Meter 33

7 Help Message 34

1. Introduction

A. Cable Connection for Multimeter Function



B. Overview

1) Modules

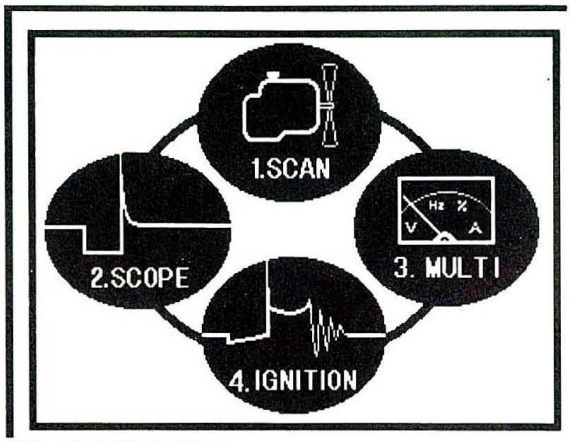
The multimeter module supports Volt, Duty Cycle, Frequency and Current Ampere measurements.

2) Measurable Range

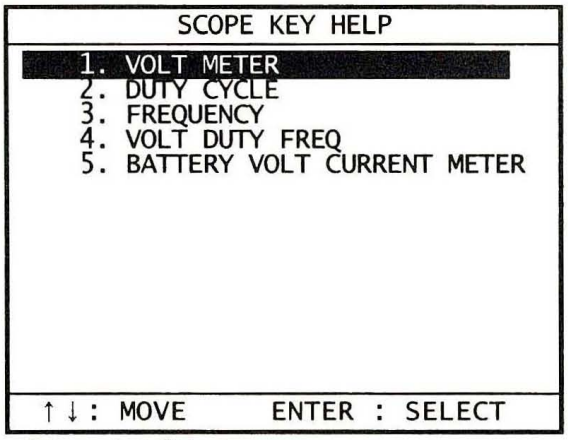
a. Voltmeter : DC ±100V
b. Duty Cycle : 0~100%
c. Duty = Low / (HIGH + LOW) × 100 (%)
d. Frequency : 5㎐ ~ 100㎑
e. Current Ampere : ±128A

C. Start Up

1) Select the [MULTI] function from the main menu by pressing the [3] key. DCN then displays the initial menu of multimeter module as ILL. 4-1.



ILL. 2-2 Main Menu



ILL. 4-1 Multimeter menu

2) To activate the sub functions, press the corresponding number or press the [ENTER] key after scrolling the highlighted bar to the desired function using [▲] and [▼] keys.

2. Voltmeter

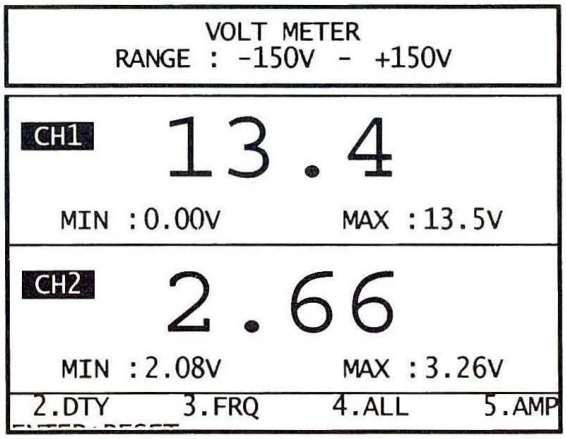
A. Range

DC voltage of 0 ~ ±150V with probes connected to CH1 and CH2.

B. Display Format

1) As shown in ILL. 4-2, the large digits in the center of the display indicate current voltage.

2) For each channel, the Maximum and Minimum voltage values are indicated in the lower lines. The Max/Min values can be reset by pressing the [ENTER] key.



ILL. 4-2 Volt Meter

3) From the menu in the bottom window, you can choose other multimeter function by pressing the corresponding number key. It is not necessary to return to the upper menu to change the mode.

a. [2. DUTY]: Changes to Duty Cycle mode
b. [3. FREQ]: Changes to Frequency mode
c. [4. ALL]: Changes to Show All mode (Volt + Duty Cycle + Frequency)
d. [ENTER]: Resets Min. and Max. values

4) Calibration

If the voltage values are not equal to zero when the probes are not attached to any voltage source, the voltage output may not be correct. If this occurs, calibration is necessary.

For proper calibration, connect the probes of each channel to the ground port of the 4-channel adaptor and then press the [0] key.

3. Duty Cycle

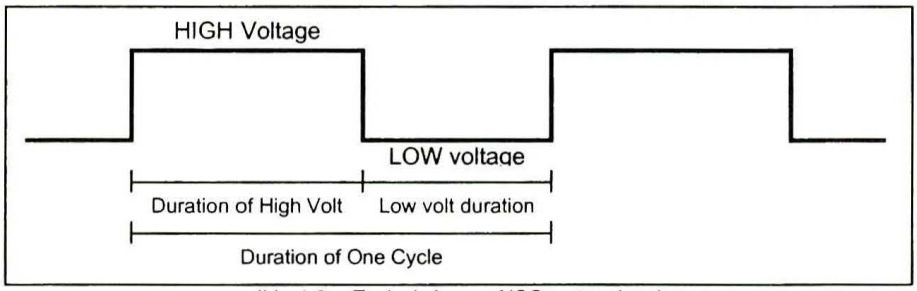
A. Duty Cycle

The Duty Cycle function can be used for the rectangular type signals.

In example, Duty Cycle is especially useful for checking the performance of Idle Speed Control motors, especially for the duty-control type vehicles as opposed to frequency or voltage control type. The engine load increases when accessories such as air conditioner, power steering or other power consuming items are running. The ISC motor therefore increases its active time to increase the engine RPM for compensation. The Duty Cycle module of DCN PRO enables the user to check this performance of ISC motor.

B. The waveform of ISC motor

General waveform of an ISC motor is rectangular as shown in ILL. 4-3.



ILL. 4-3. Typical shape of ISC motor signal

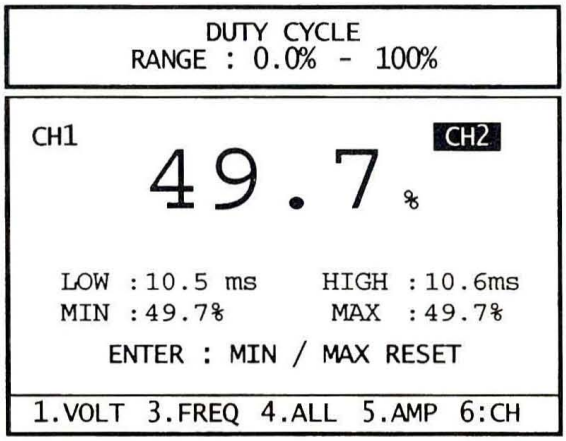
The low voltage indicates that the ISC motor is running. The duty cycle is calculated by dividing the duration of low voltage by the duration of one cycle. The resulting duty cycle is expressed in a percentage.

$$\text{DUTY CYCLE} = \frac{\text{Duration of LOW voltage}}{\text{Duration of one cycle (LOW+HIGH)}}$$

C. Display Format

1) As shown in ILL. 4-4, big digits in the center of the display indicate the duty cycle.

2) Duration of LOW and HIGH voltages are indicated on the bottom of the screen in milliseconds.
Maximum and Minimum ratios are also indicated just below Low / High values.



ILL. 4-3 Duty Cycle

3) Pressing the [ENTER] key resets the Minimum and Maximum values

4) From the menu in the bottom window, you can change the multimeter mode by pressing the corresponding number key.

5) You can change the signal input channel by pressing the [6] key.

4. Frequency

A. Range

Frequency meter measure values between 5㎐ ~ 100㎑ with probes connected to CH1 or CH2.

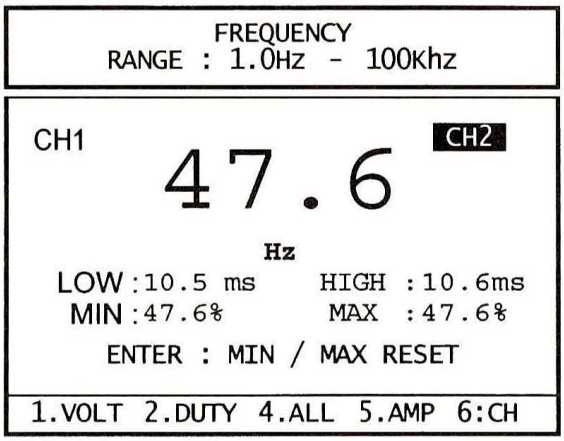
B. Display Format

1) As shown in ILL. 4-4, big digits in the center of the display indicate measured frequency in hertz or kilo hertz.

2) The active channel is highlighted. The signal input channel may be changed by pressing the [6] key.

3) Frequency range is indicated at the bottom. Press the [ENTER] key to reset the MAX and MIN values.

4) You can also run the multimeter and duty cycle module by pressing the [1] or [2] key without returning to the upper menu.



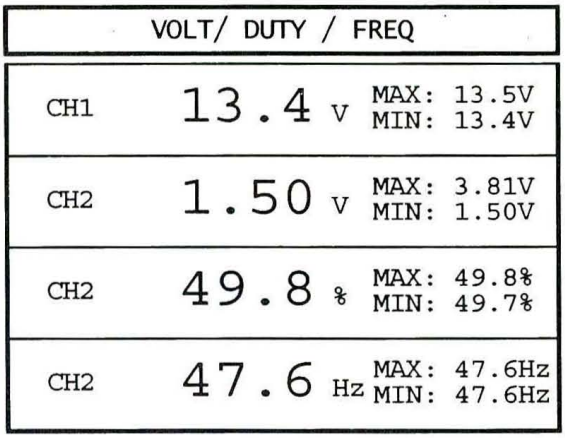
ILL. 4-4 Frequency

5. Show All Mode - Volt Duty Freq

DCN displays voltage(2), duty cycle and frequency on one by selecting the [4. Volt Duty Freq] module from the multimeter menu as shown in ILL. 4-5.

In this module, it is not necessary to select each module to view these values separately.

To go back to the upper menu, press the [ESC] key.

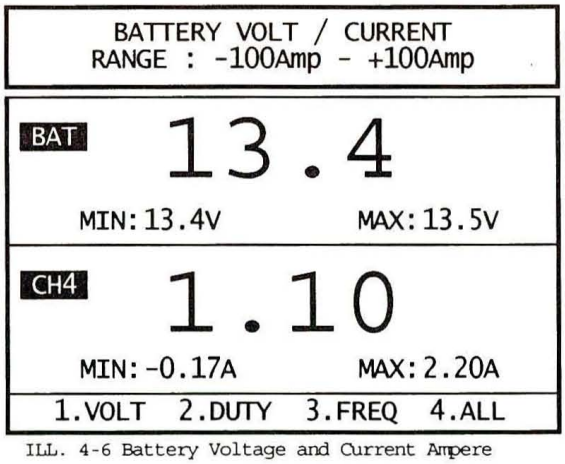


ILL. 4-5 Show All Mode

6. Battery Voltage / Current Meter

Measures battery voltage and ampere current.

The current Probe must be connected to the (+) or (-) terminals of vehicle battery for measurement.

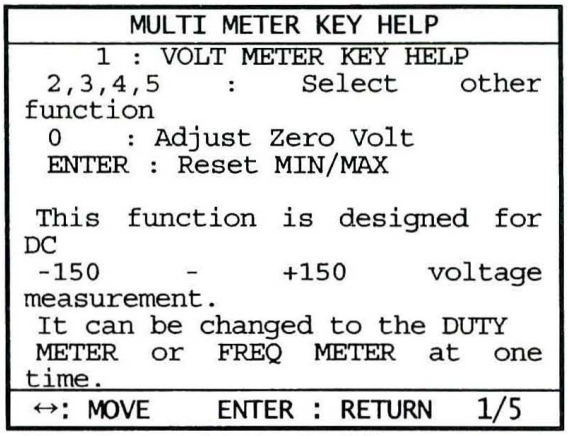


ILL. 4-6 Battery Voltage and Current Ampere

7. Help Message

Press the [HELP] key to view the Key Explanation for each multimeter function.

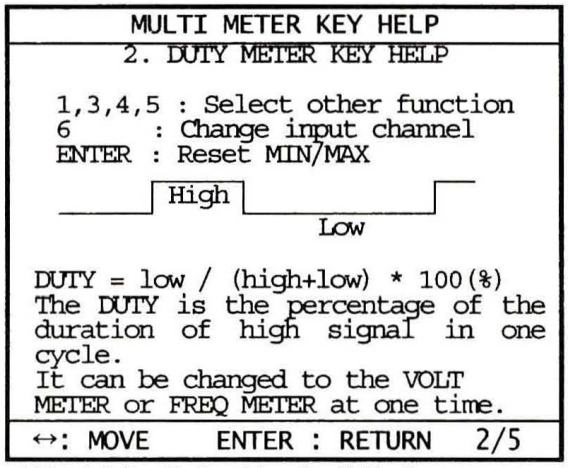
When you press the [HELP] key in the Voltage Meter mode, the key explanation for Voltage Meter function is displayed as shown below:


MULTI METER KEY HELP
1 : VOLT METER KEY HELP
2,3,4,5 : Select other function
0 : Adjust Zero Volt
ENTER : Reset MIN/MAX
This function is designed for DC
-150 - +150 voltage measurement.
It can be changed to the DUTY METER or FREQ METER at one time.
↔: MOVE ENTER : RETURN 1/5

ILL. 4-7 Key Explanation for Voltmeter

For each function, you can view the key explanations by pressing the [HELP] key.

ILL. 4-8 shows the key explanation of the Duty Cycle function.


MULTI METER KEY HELP
2. DUTY METER KEY HELP
1,3,4,5 : Select other function
6 : Change input channel
ENTER : Reset MIN/MAX
High
Low
DUTY = low / (high+low) * 100(%)
The DUTY is the percentage of the duration of high signal in one cycle.
It can be changed to the VOLT METER or FREQ METER at one time.
↔: MOVE ENTER : RETURN 2/5

ILL. 4-7 Key Explanation for Voltmeter

Key explanations for all five multimeter modes are provided. You can view the key explanations on other functions by pressing the [◀] or [▶] keys.

Chapter 5. Ignition Pattern Analysis

1. Introduction 36

2. Ignition – Primary Pattern 41

3. Ignition – Secondary Pattern 51

4. Ignition Pattern – DLI Vehicles 55

5. Printer Output 63

1. Introduction

A. What is an Ignition Pattern?

An Ignition Waveform is a graphical representation of voltage fluctuations in a recurring procedure - the high voltage from the secondary ignition coil which is created when the electric power in the primary coil that was fully charged by power TR collapses when the power TR is turned off. This produces a spark over the gap of the spark plug in the cylinder, which is used for combustion of the air-fuel mixture.

DCN PRO can analyze both Primary and Secondary Ignition Waveforms.

B. Purpose of Ignition Pattern Analysis

The Ignition Waveform Analysis function of the DCN PRO is to provide an accurate visual representation of ignition waveforms to enable the user to analyze the possible causes of problems within the ignition system.

By designating X(horizontal) axis for time and Y(vertical) axis for voltage, the change of voltage in relation to elapsed time during the spark-ignition sequence can be graphed as a waveform. Waveforms have typical characteristics of height and duration that can be influenced by various factors.

Since each of these factors brings about a noticeable change in the ignition waveform, the cause of a malfunction can be traced by analyzing the transformed waveform in reverse.

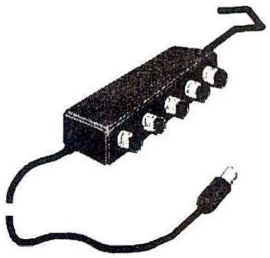
C. Basic Supplies for Ignition Waveform Analysis

The following items are provided for use with Ignition Waveform Analysis procedure:

#1 Cylinder Pick-up Clamp

Probe for Secondary Pattern
– No needle. Red.

Probe for Primary Ignition Signal
- Needle. 4 units. Black.



4 Channel Adaptor

Ground Connector

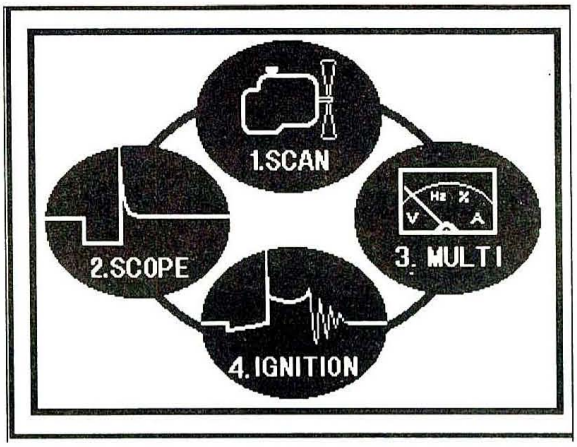
D. Initialization

1) Application

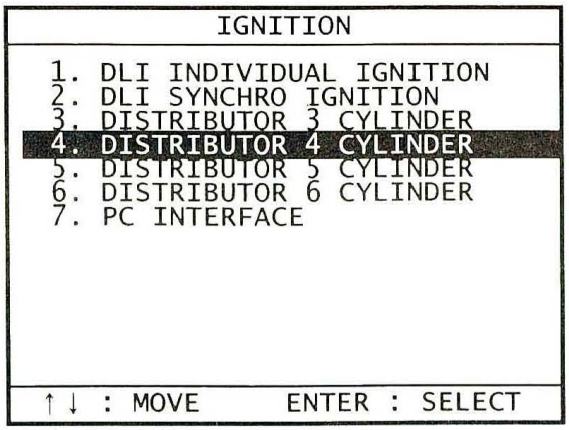
The Ignition Waveform function of DCN PRO may be used on conventional vehicles with Distributor type ignition for 1~6 cylinder(s) and on DLI/DIS (Distributorless or Non-distributor ignition) type vehicles.

2) Start-up

After properly connecting the probe, clamp and other cables, turn on DCN PRO and begin the Ignition Waveform function by pressing the [4] button. Cable connections are explained in detail in the next section.



ILL. 2-2 Main Menu

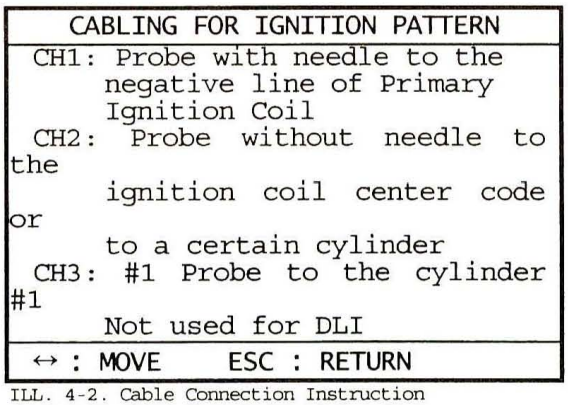


ILL. 4-1. Initial Menu of Ignition Pattern Function

The ignition type and number of cylinders can be chosen from the initial menu. The default is 'Distributor 4 Cylinder' since they are the majority of the passenger cars on the market.

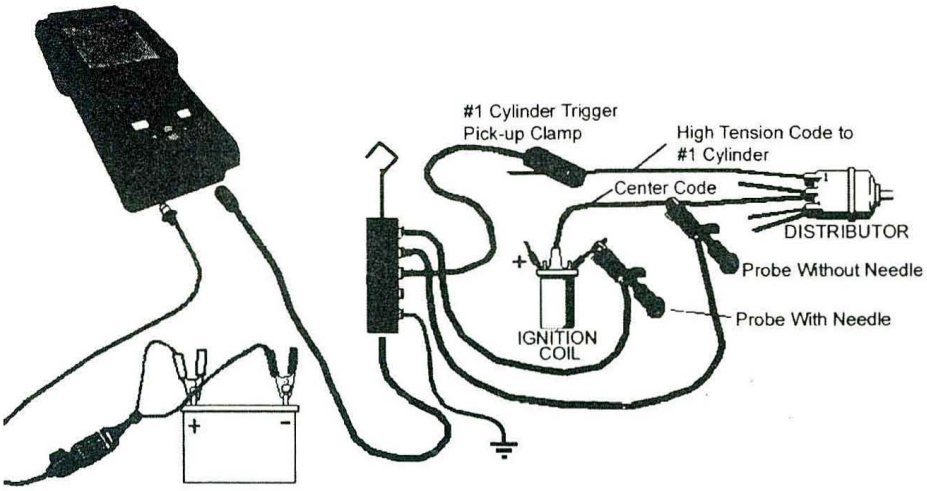
E. Cable Connection

After selecting a vehicle type, press the [HELP] key to view the instructions for cable connection.


CABLING FOR IGNITION PATTERN
CH1: Probe with needle to the negative line of Primary Ignition Coil
CH2: Probe without needle to the ignition coil center code or to a certain cylinder
CH3: #1 Probe to the cylinder #1 Not used for DLI
↔ : MOVE ESC : RETURN

ILL. 4-2. Cable Connection Instruction

When the cable connections have been properly made, press the [ENTER] key. The ignition pattern display will follow.



Basic Cabling for Ignition Pattern Analysis

Adaptor		Vehicle
Scope CH1 PRIM. IG.	Probe with needle (Part No. H-CP-008)	Ignition Coil Primary Side Negative Line
Scope CH2 SCND. IG.	Probe without needle (Part No. H-CP-018)	Center Cable Ignition Coil ↔ Distributor
Scope CH3 CYL1 TRIG	#1 Cylinder Pickup Clamp (Part No. H-CP-019)	High Tension cord to Cyl #1 High Tension cord of (-) discharge for DLI
Scope CH4 CURRENT	Current Probe (Part No. H-CP-020)	Battery Line (+ or -)
GROUND	Ground Connector (Part No. H-CP-009)	Any metal part of the vehicle

1) Trigger Pick-up Clamp

- Connect the clamp to the Spark Plug Cable of Cylinder #1: See NOTICE
- Plug the other end to the 4CH adaptor CH3 port.

NOTICE

You will find the inscription 'This side to the spark plug' on one side of the clamp. Connect the clamp to the spark plug cable of cylinder #1 so that the inscribed side faces the #1 cylinder spark plug. The spark plug that is nearest to the generator is usually the #1 plug.

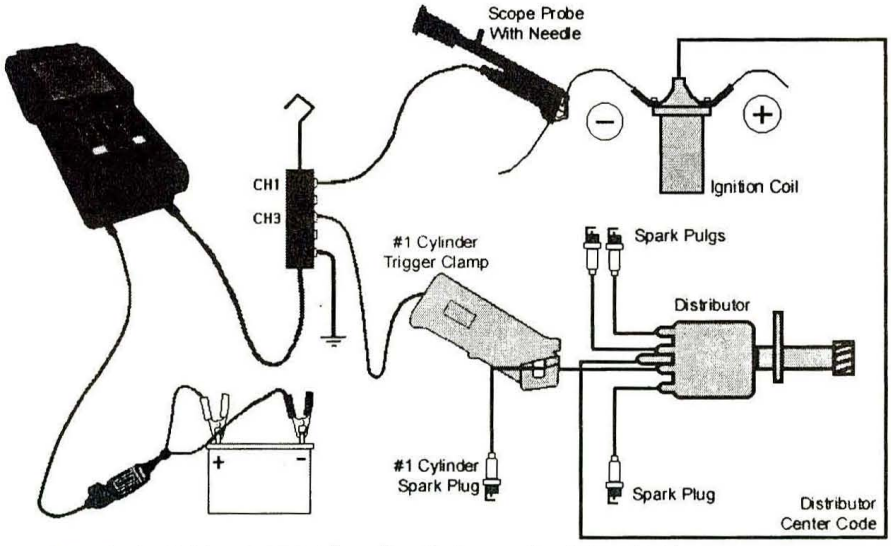
When the clamp is connected properly and the clamp picks up the trigger well, then DCN PRO will indicate it by flickering the ground mark (▼) on screen.

When the clamp is not connected properly, a waveform may still be displayed but without or incorrect cylinder numbers. In case the high tension cable is not available or the #1 cylinder doesn't ignite, the clamp should be connected to the spark plug cable of the other cylinder. The ignition order will then be determined.

DCN PRO recognizes the cylinder to which the trigger pickup clamp is connected to be Cylinder #1. The ignition order of 4-cylinder engines is usually 1-3-4-2. For example, if the clamp is connected to cylinder #3, the ignition waveform will be displayed in a row as 3-4-2-1 while DCN still displays the cylinder indicator as 1-3-4-2. Accordingly, when connected to cylinder #2, the

2) Primary Ignition Signal

- Connect the probe with needle to the negative (-) line of the PRIMARY ignition coil
- Plug the other end to DCN PRO's channel 1 port



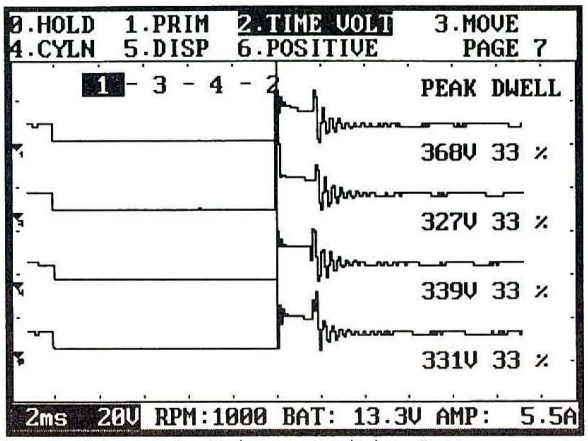
ILL. 4-3. Cable Connection for Primary Ignition Pattern

2. Ignition – Primary Pattern

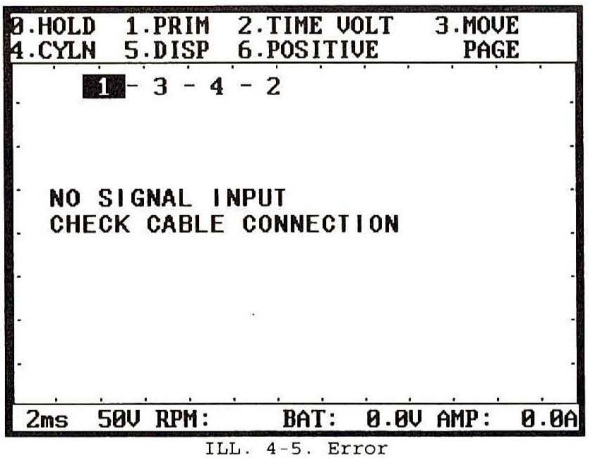
A. Primary Ignition Waveform Analysis

1) Pattern Display

When the probes are connected properly and DCN PRO receives proper signal from the vehicle, the Primary Ignition Pattern will be displayed as ILL. 4-4.


0.HOLD 1.PRIM 2.TIME VOLT 3.MOVE
4.CYLN 5.DISP 6.POSITIVE PAGE 7
1 - 3 - 4 - 2
PEAK DWELL
368V 33 %
327V 33 %
339V 33 %
331V 33 %
2ms 20V RPM:1000 BAT: 13.3V AMP: 5.5A

ILL. 4-4. Primary Ignition Pattern


0.HOLD 1.PRIM 2.TIME VOLT 3.MOVE
4.CYLN 5.DISP 6.POSITIVE PAGE
1 - 3 - 4 - 2
NO SIGNAL INPUT
CHECK CABLE CONNECTION
2ms 50V RPM: BAT: 0.0V AMP: 0.0A

ILL. 4-5. Error

2) Error

In case of improper cable connection or signal pickup failure, an error message as shown in ILL. 4-5 will appear.

a. Improper Cable Connection : Check the cable connection

b. Signal Pickup Failure: Check if there is any signal input through CH1 line using the Oscilloscope function of DCN PRO. As explained previously, end the Ignition Pattern function and choose the Oscilloscope Function from the main menu. Choose the [11. Primary IG] from the Auto setup menu for CH1.

c. If the engine is running, the ignition coil must be generating the primary voltage. And if there is no signal found, the probe is connected to an incorrect line.

⚠ DANGER

CAUTION!

Be sure NOT TO attach the probe needle to any high tension cables attached to the ignition plugs or the center cord that connects the distributor and ignition coil. The voltage of these lines may reach up to 50,000V. It is extremely dangerous to attach the probe needle to such high voltage lines.

B. Display Control

The user can tailor the ignition waveform display to suit his preference or purpose with the following functions such as magnify / demagnify, move / shift, save / load, etc.

For all waveform displays,

- Control functions are listed on top
- Waveform display and messages in the center
- Current status - time & voltage division, engine RPM, Battery Voltage and Current Ampere in the bottom.

Available Control Functions are HOLD, PRIM/SCND, TIME/VOLT, MOVE, CYLN, DISP, POSITIVE/NEGATIVE, GRID, SAVE, RCLL.

NOTICE

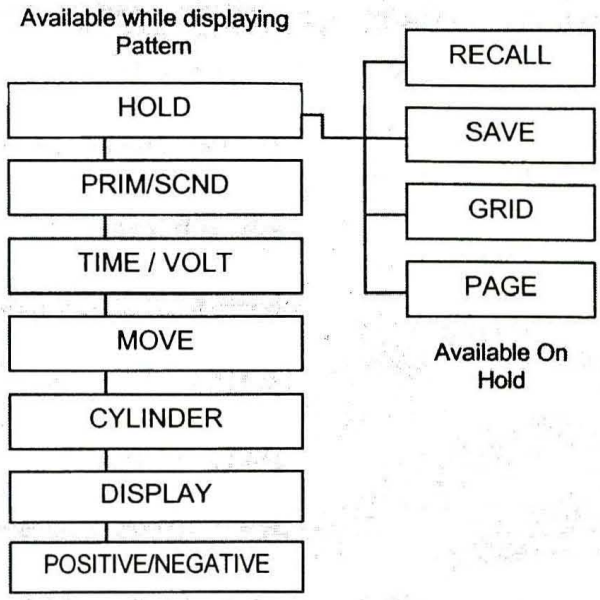
Limited LCD space prohibits listing all functions at once.

The function selection procedure can be summarized as illustrated on the right.

With regard to the operational flow, the functions have been divided as follows:

Those functions that are available while the patterns are being displayed will always appear.

The save and recall functions that are usable only when the pattern display is stopped will appear when the operation is on hold.



1) [0. HOLD]

Holds the waveform display and displays extensive control functions

○ Before [0.HOLD] is selected, the functions

0.HOLD, 1.PRIM / SCND, 2.TIME VOLT, 3.MOVE, 4.CYLN, 5.DISP, 6. POSITIVE / NEGATIVE are listed

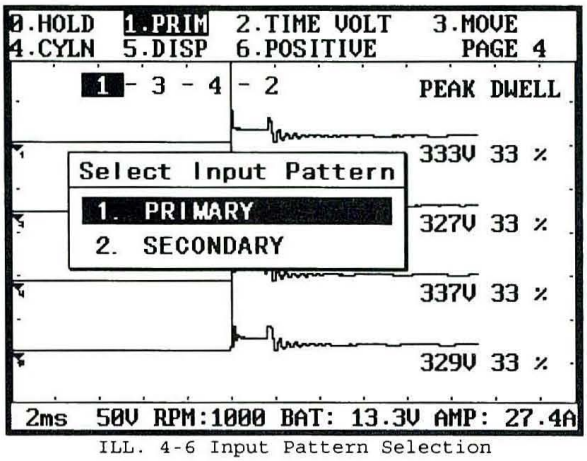
○ When [0.HOLD] is selected, the functions

0.GRID, 1.PRIM / SCND, 2.TIME VOLT, 3.MOVE, 4.CYLN, 5.DISP, 6. SAVE, 7. RCLL 8. PAGE will be shown. These functions are available when the display is paused. Notice that only functions No. 0, 6, 7 and 8 are changed.

2) [1.PRIM]

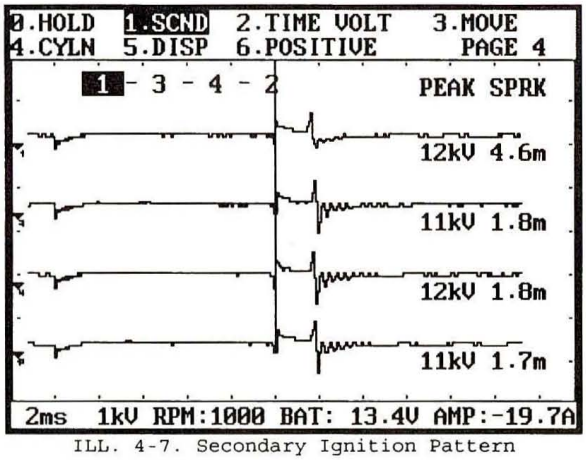
Primary Ignition pattern ↔ Secondary Ignition Pattern

When the [1] key is pressed during a waveform display, the ignition pattern display selection menu will appear as shown in ILL. 4-6.



ILL. 4-6 Input Pattern Selection

If you select [2. Secondary], the display mode will be changed to the Secondary Ignition Pattern mode. Secondary Pattern will be explained in detail in the following sections.



ILL. 4-7. Secondary Ignition Pattern

3) [2. TIME VOLT]

Changes time and volt division

○ Time Division : When the [◀][▶] keys are pressed, the time division increments

change between values of 0.5㎳ → 1㎳ → 2㎳ per grid.

Default = 2㎳

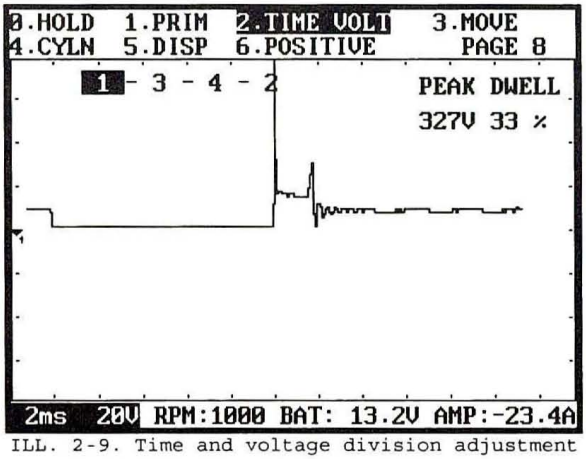
Consequently, the change of time division also serves as a horizontal detail control function

○ Voltage Division : When the [▲][▼] keys are pressed, the voltage division increments change between values of 1V→2V→5V→10V→20V→50V→100V per grid

Default = 50V

Consequently, the change of volt division also serves as a vertical detail control function

○ When the procedure is paused by pressing the [0](HOLD) key, the voltage control function will not be available in the primary ignition waveform mode. Voltage control is still available in the secondary waveform mode.

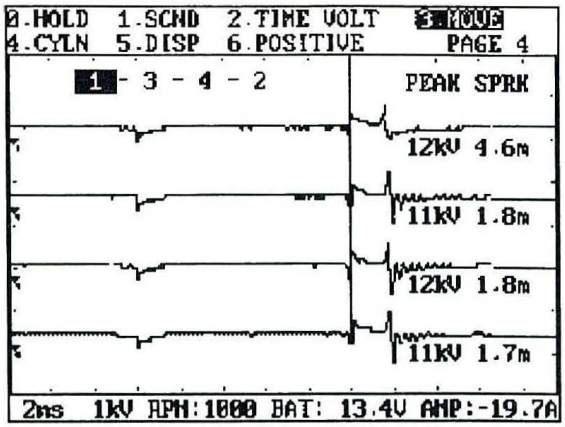


ILL. 2-9. Time and voltage division adjustment

4) [3. MOV]

Moves the waveform

The waveform being currently displayed can be moved left / right and up / down by pressing the [◀][▶][▲][▼] keys after pressing the [3] key.



ILL. 4-9. Ignition Pattern Move

5) [4. CYL]

Selects a cylinder in single(individual) waveform display mode

○ For the 4-cylinder distributor type engine, the waveform of cylinder #1 will be displayed first. Waveforms of other cylinders are to be displayed in turn when the [◀] or [▶] keys are pressed after pressing the [4] key. As explained before, the firing order of most 4-cylinder engine is 1-3-4-2. As for 5 or 6 cylinder engines, the user needs to enter the firing order separately.

○ In the waveform display, the cylinder number is highlighted as 1-3-4-2. As the [▶] key is pressed, the waveforms of the other cylinders will be selected in turn, 1-3-4-2, 1-3-4-2 and 1-3-4-2. For 3-cylinder engine, the sequence is 1-3-2.

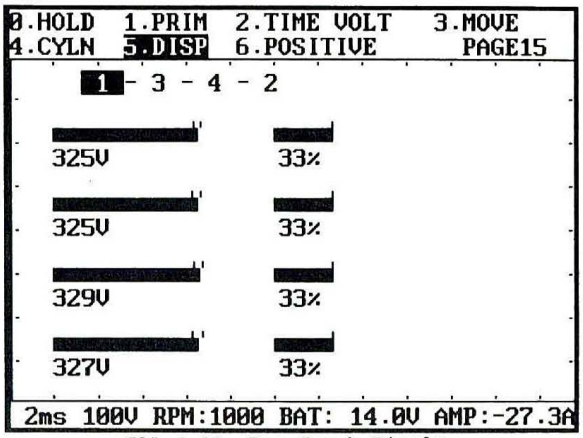
6) [5. DISP]

Changes Display mode to Single, Parallel Waveform or Bar Graph

○ SINGLE : Single display that shows a single waveform per cylinder (ILL.4-10)

○ PARALL : Parallel display that shows waveforms of multiple cylinders

○ BAR GRAPH : Displays the maximum voltage of cylinders by histogram and numerical values. Dwell Angles of each cylinder are displayed together.



ILL.4-11. Bar Graph Display

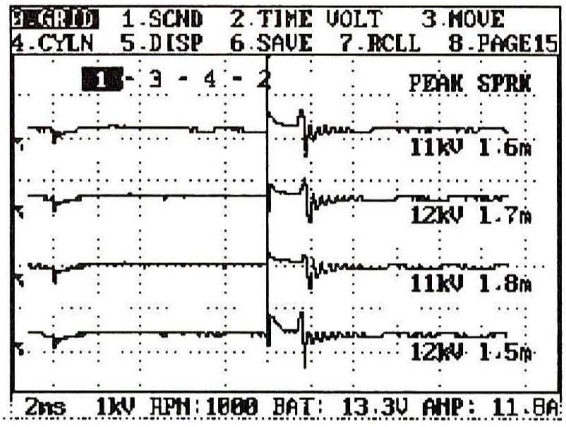
7) [6. POSITIVE / NEGATIVE]

Selects the discharge polarity.

Only used for DLI ignitions.

8) [0. GRID]: When on 'HOLD'

Toggles grid On / Off



ILL. 4-12. Grid On

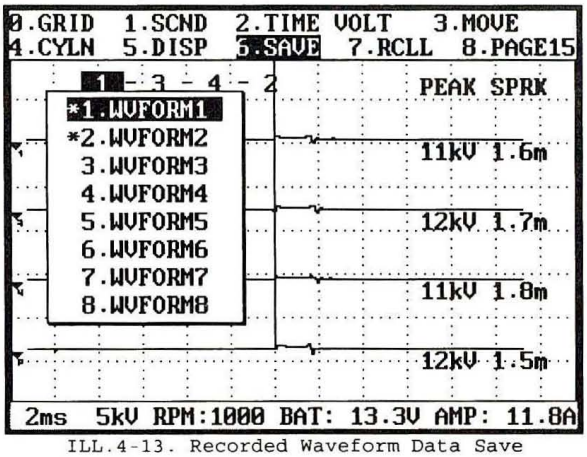
9) [6. SAVE] : When on 'HOLD'

Saves recorded waveform data

This function is the same as explained in Oscilloscope section. DCN PRO records waveform data up to 50 frames. You can review the recorded data by selecting [8. PAGE]

The waveform data will be erased when resuming the waveform display unless it is saved to DCN PRO's memory. This [SAVE] function must be used to save the recorded data. The saved data may still be downloaded to your PC.

Select the memory slot to save the data and then press the [ENTER] key. Used slots are marked with an ' * '.



ILL.4-13. Recorded Waveform Data Save

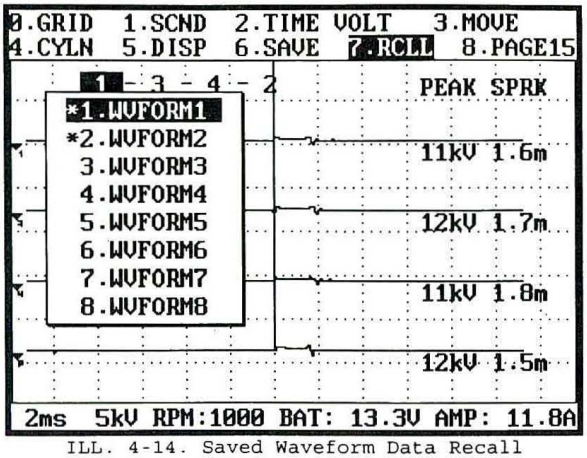
10) [7. RCLL] : When on 'HOLD'

Recalls the previously saved waveform data

○ DCN PRO can store up to 8 waveforms in its memory. Refer to the paragraph 9 to see how to save recorded data.

○ 8 memory slots will be listed as [#.WVFORM#] (they can not be renamed), when

[7. RCLL] is selected by pressing the [7] key. The slot which contains waveform data will be marked with an ' * '.



ILL. 4-14. Saved Waveform Data Recall

- ○ Choose the memory slots by pressing [ENTER] after selecting the slot by using the [▲] and [▼] keys.
- ○ To delete the saved data from the memory slot, press [ERASE] after Locating the highlight bar on it.

11) [8. PAGE]: When on 'HOLD'

Reviews the temporarily recoded waveform data

- ○ DCN PRO automatically records waveform data up to 50 frames and repeats this process [0.HOLD]. is chosen.
- ○ You can review the recorded waveform data by pressing the [▲] or [▼] keys.
- ○ The data is recorded temporarily and will be removed when you press the [ESC] key.

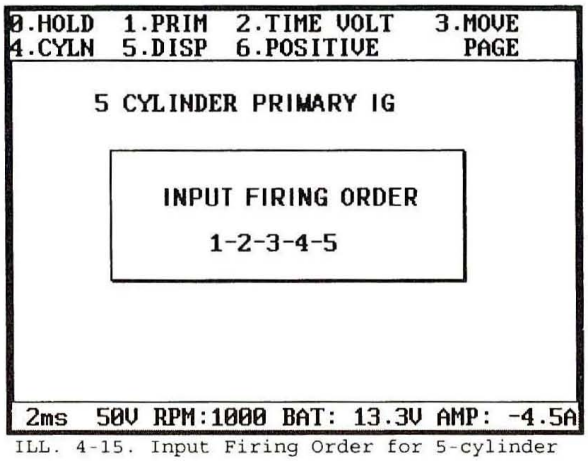
  To preserve the data for future use, choose [6.SAVE], and save the data to DCN PRO's internal memory.

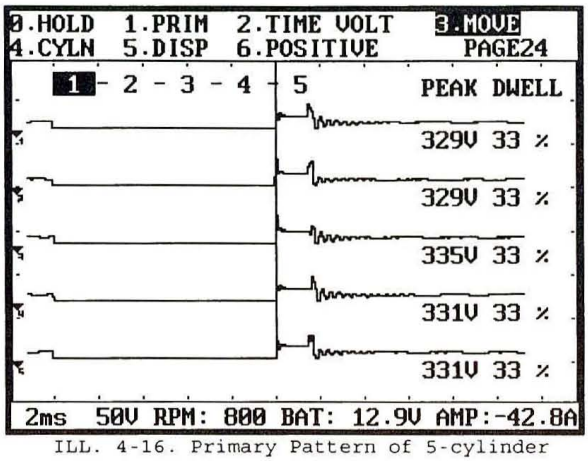
C. Primary Ignition Pattern of 5 or 6 cylinder distributor type engines

While the ignition(firing) order of 4 cylinder engines is 1-3-4-2, the firing orders of 5 or 6 cylinder engines may differ. It is therefore necessary to manually enter the firing order for 5 or 6 cylinder engines. All other procedures remain the same.

1) How to input a Firing Order

○ The message to input the firing order will be shown when [Distributor 6 (or 5) cylinders] is selected from the engine type selection menu as in ILL. 4-15. Default order for 6 cylinder engine is 1-2-3-4-5-6. If the vehicle's firing order differs from this, it will be necessary to enter the correct firing order.


0.HOLD 1.PRIM 2.TIME VOLT 3.MOVE
4.CYLN 5.DISP 6.POSITIVE PAGE
5 CYLINDER PRIMARY IG
INPUT FIRING ORDER
1-2-3-4-5
2ms 50V RPM:1000 BAT: 13.3V AMP: -4.5A
ILL. 4-15. Input Firing Order for 5-cylinder


0.HOLD 1.PRIM 2.TIME VOLT 3.MOVE
4.CYLN 5.DISP 6.POSITIVE PAGE24
1 - 2 - 3 - 4 - 5
PEAK DWELL
329V 33 %
329V 33 %
335V 33 %
331V 33 %
331V 33 %
2ms 50V RPM: 800 BAT: 12.9V AMP:-42.8A
ILL. 4-16. Primary Pattern of 5-cylinder

○ Type the cylinder numbers using the numeric keypad in sequence and then press [ENTER].

For example, when the firing order is 1-5-3-6-2-4, press 1, 5, 3, 6, 2, 4 in sequence and then press the [ENTER] key.

○ After pressing [ENTER], a message for probe and clamp connection will be displayed. Press the [ENTER] key again when the clamp, probe and cable connections are properly completed. The waveform display will then follow.

○ The newly entered ignition order will be shown in the upper part of the display in the same manner as with a 4-cylinder engine.

○ Parallel waveforms of 6 cylinder engines can be displayed in a single screen as shown in ILL. 17. Peak voltage histograms may also be displayed in one screen.

3. Ignition – Secondary Ignition Pattern

A. Cable Connection

1) Trigger Pick-up Clamp

a. Connect the clamp to the High Tension Code of Cylinder #1
b. Plug the other end to DCN PRO's channel-3 port

2) Center Cord Probe

a. Attach the probe (red without needle) to the center cord that connects the distributor and ignition coil

NOTICE

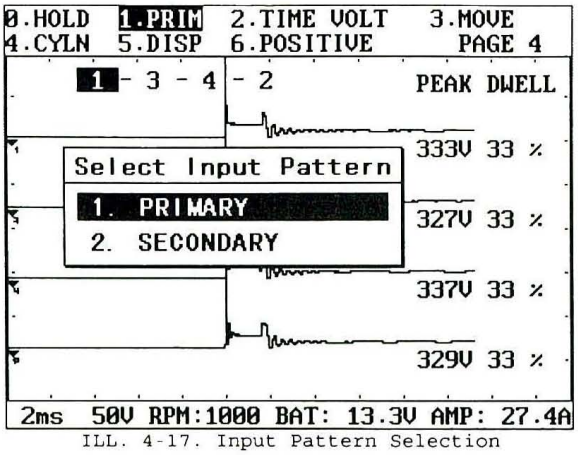
If the clamp is not properly connected, a waveform will still be displayed but without cylinder numbers. If the spark plug cable is not available or the #1 cylinder doesn't ignite, the clamp should be connected to a spark plug cable from another cylinder. The firing order will then be determined.

The firing order of 4-cylinder engine is usually 1-3-4-2. For example, when the clamp is connected to #3 cylinder, the ignition waveform will be displayed in a row as 3-4-2-1. Similarly, when connected to #2 cylinder, the order will be 2-1-3-4 and when connected to #4 cylinder, the order will be 4-2-1-3.

b. Plug the other end to DCN PRO's channel 2 port

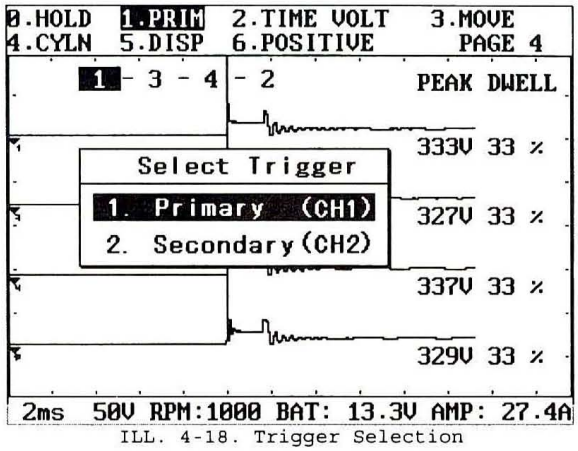
B. Menu Selection

If you select [1.PRIM] during the Primary Pattern Display, the Input Pattern Selection menu will appear.



ILL. 4-17. Input Pattern Selection

Choose [2. SECONDARY], then Trigger Selection Menu will follow as shown in ILL. 4-18.



ILL. 4-18. Trigger Selection

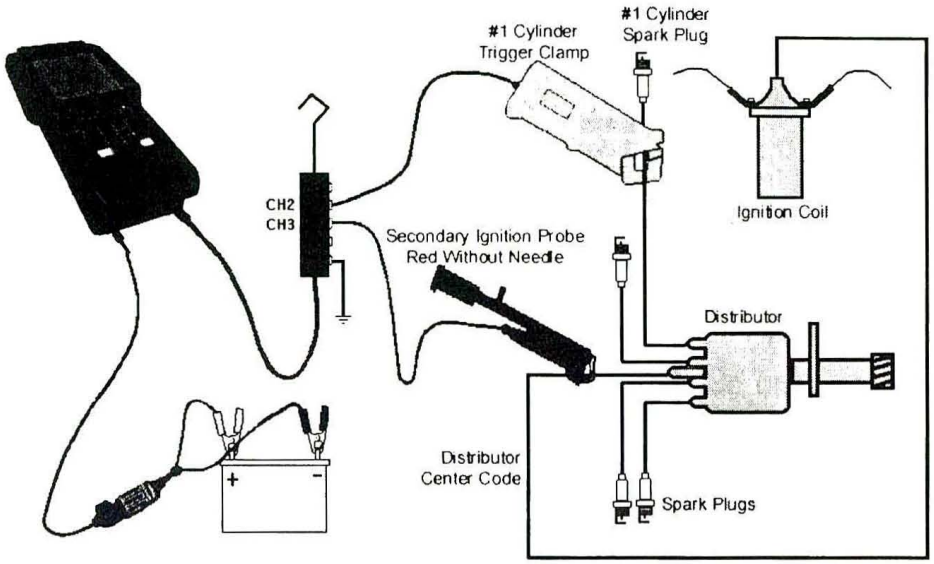
C. Trigger Selection

1) The probe that receives the trigger signal can be selected.

2) This trigger selection method has been designed to obtain better secondary ignition patterns of Distributorless vehicles(DLI). On some DLI cars, the primary lines may be difficult to find.

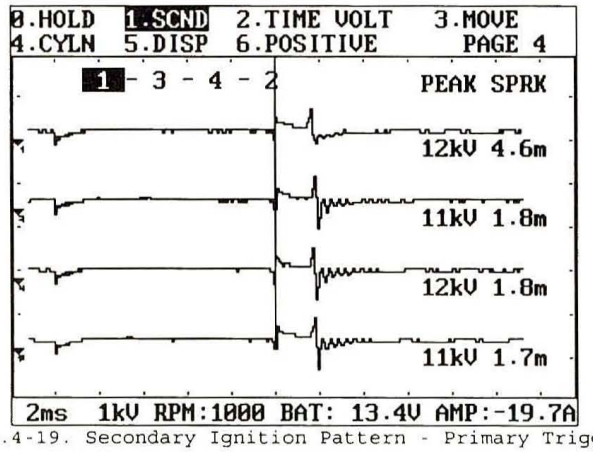
3) Since it is very easy to find the primary lines for conventional cars with distributor type ignition, we strongly recommend that the 'Primary signal' is selected as the trigger. The secondary signal is not stable enough since it fluctuates in relation to engine RPM and engine load. In this case, DCN PRO may fail in displaying the correct voltage lines.

4) To use the primary signal as the trigger, connect the scope probe with needle to the primary side negative line of ignition coil and the other end to CH1 port of DCN PRO (these cable connections are always recommended for all cars with distributor ignition)



Choose [1. Primary (CH1)] and then press the [ENTER] key.

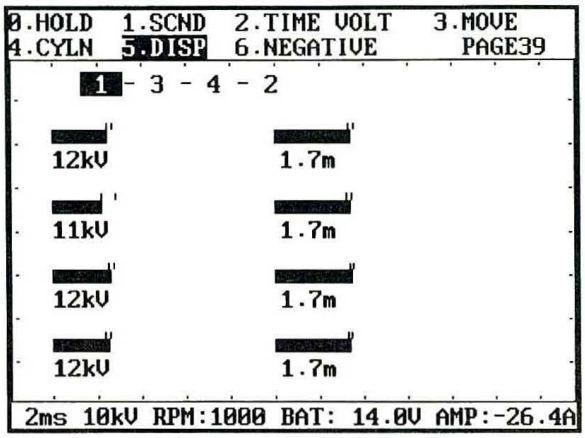
A message for cable connection will follow. Press [ENTER] again. Then Secondary Patterns will be displayed.



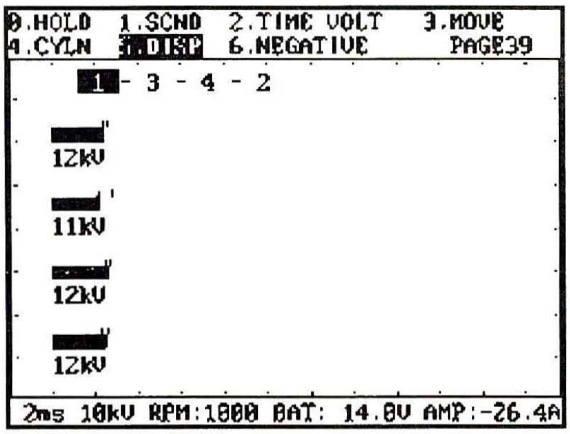
ILL.4-19. Secondary Ignition Pattern - Primary Trigger

5) ILL.4-19 shows the patterns using Primary trigger signal. In case the Secondary trigger has been selected, the voltage lines may be unstable. Also the Spark Time will not be displayed.

6) In Bar Graph mode, the spark time and peak voltage will be displayed together if the Primary trigger has been selected. If the Secondary trigger has been selected, only the peak voltage will be indicated. (ILL. 4-20~21).



ILL.4-20. Secondary Bar Graph - Primary Trigger



ILL.4-21. Secondary Bar Graph - Secondary Trigger

D. Display Control Functions

Refer to the Primary Pattern part.

4. Ignition - DLI / DIS Engines

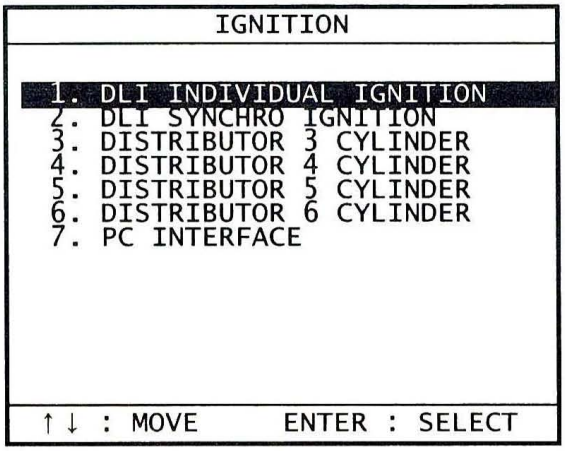
'DLI' stands for Distributor-Less Ignition - An ignition system without a distributor.

Since a DLI vehicle has an ignition coil for each ignition plug or one for every two plugs, it requires different procedures for correct connections and data display.

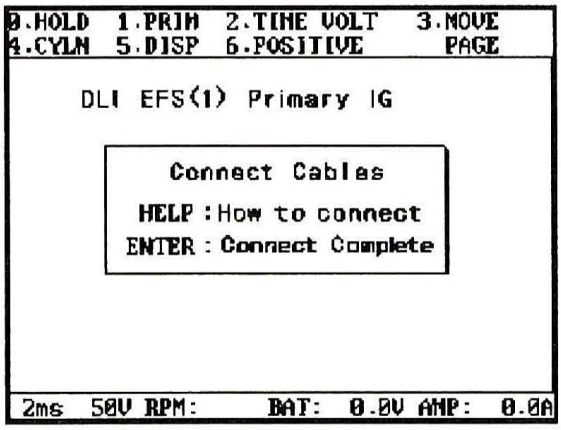
A. Individual Ignition Type

1) Menu Selection

a. Select '1. D.L.I. Individual Ignition' type from the engine type selection menu. DCN then displays the cable connection message.

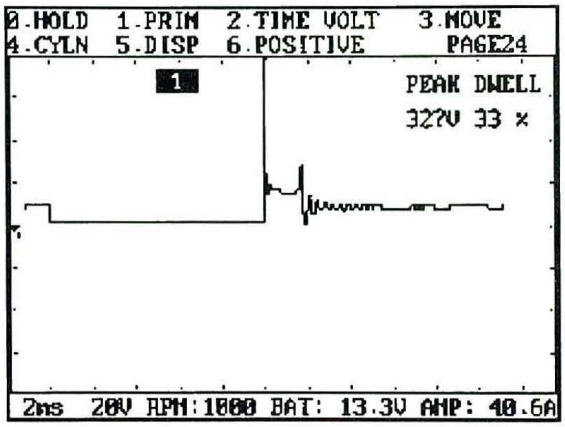


ILL. 4-22. Initial Menu of Ignition Pattern Function


0.HOLD 1.PRIM 2.TIME VOLT 3.MOVE
4.CYLN 5.DISP 6.POSITIVE PAGE
DLI EFS(1) Primary IG
Connect Cables
HELP : How to connect
ENTER : Connect Complete
2ms 50V RPM: BAT: 0.0V AMP: 0.0A

ILL. 4-23. Connect Cables message

b. When the [ENTER] key is pressed, the message 'searching for signal' will appear briefly. The Primary Ignition Pattern will then be displayed (should the secondary trigger has been selected, the secondary pattern will be displayed).



ILL. 4-24. DLI Primary Ignition

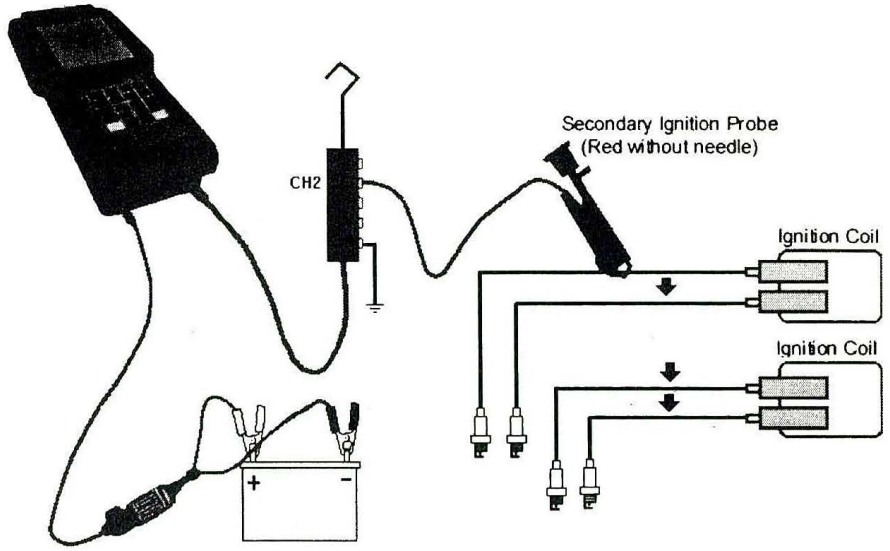
2) Secondary Ignition Pattern

a. To change to Secondary Pattern, select [1.PRIM] by pressing the [1] key while displaying the Primary Pattern.

b. Trigger Selection
For Secondary Ignition Pattern display, the trigger signal must be selected.

- **Secondary Signal**: Picks up the trigger signal from the Secondary Pattern itself. Just attach the probe without needle(red) to one of the high tension cables that extend to each spark plug, and the other end to CH2. No connection for CH1.

- **Primary Signal**: Picks up the trigger signal from the Primary Pattern. Connect the probe with needle to the primary side negative line of ignition coil, and the other end to CH1 port. And the probe without needle(red) to a high tension cable and CH2.



NOTICE

It is easy and simple to use the secondary signal as trigger - just connect the probe without needle to a high tension cord. That is all.

However, since the secondary signal is easily affected by engine RPM and engine load, the resulting waveform may be incorrect and unstable. Therefore, it is always recommended to use the Primary signal as a trigger.

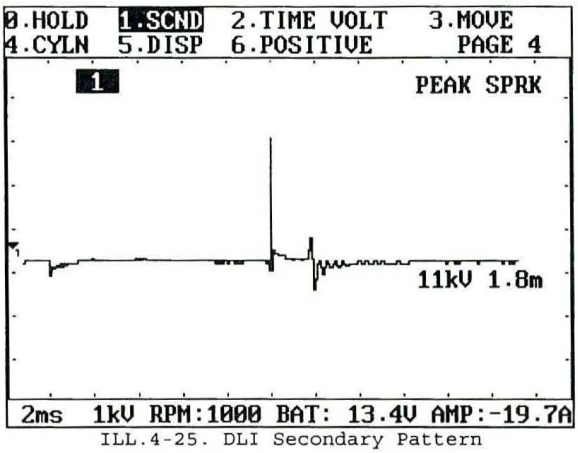
Despite all the reasons for use of primary ignition signal, sometimes it is necessary to use the secondary trigger signal when the primary lines cannot be found. Sometimes the lines of some DLI cars are hidden under metal shields and plates or may be too short for proper attachment of the probe.

Trigger Signal	Probe with needle	Probe without needle	Waveform output
Primary	CH1. Negative line of primary ignition coil	CH2. High tension cable to ignition plug	Primary and Secondary (stable)
Secondary	NONE	CH2. High tension cable to ignition plug	Secondary only (unstable)

c. Press the [ENTER] key when the cable connection is completed. The secondary patterns will then be displayed.

3) Secondary Ignition Waveform Output

a. When all probe and cable connections have been correctly made, the ignition waveform will be displayed as shown in ILL-4-25.



ILL.4-25. DLI Secondary Pattern

b. For individual ignition DLI engines, the patterns of each cylinder must be viewed one by one. Connect the probe without needle to the other high tension cable, and then repeat the previous procedure. The cylinder number will always be marked 1.

4) Display Control Functions

a. CYLN and DISP functions are not available with individual ignition DLI engines.
Only one pattern per cylinder may be viewed at a time.

b. All other functions perform the same as previously explained. Refer to the section on distributor type ignition vehicles.

B. Synchronized Ignition Type - Double Ended Coil

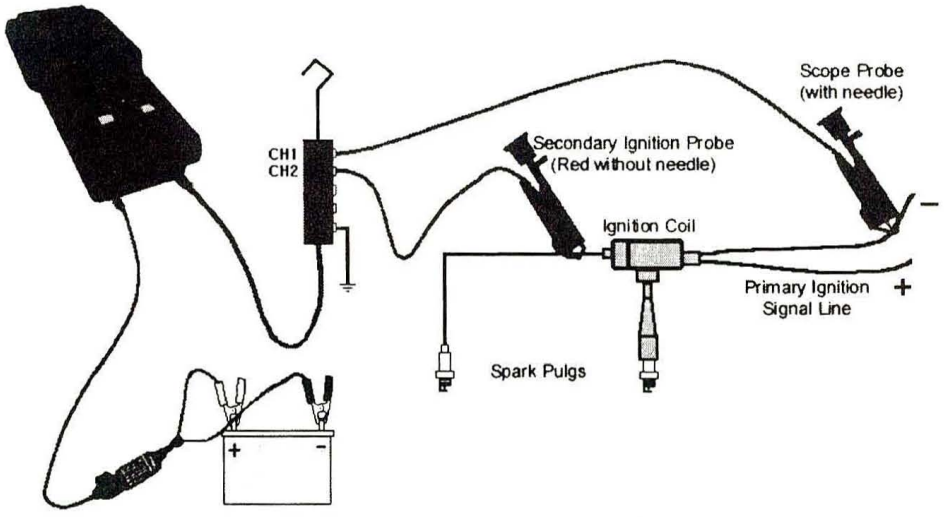
1) Trigger Selection and Probe Connection

a. Double ended coil type DLI engines: Two spark plugs per ignition coil

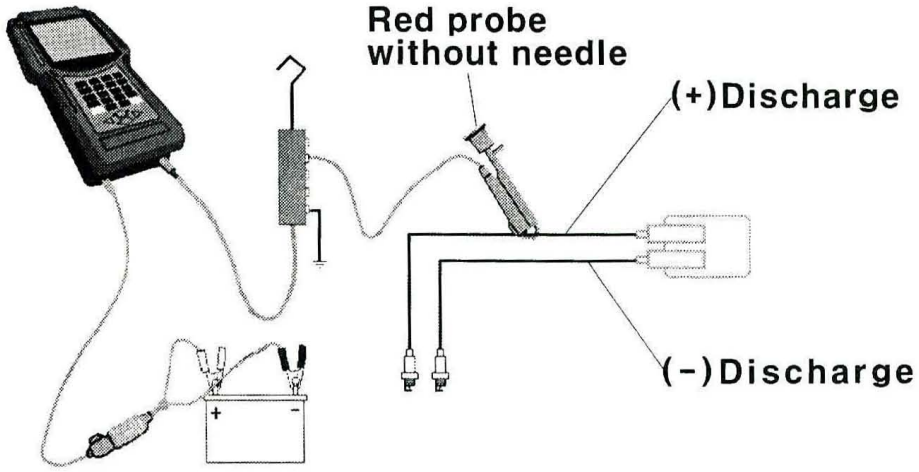
b. These kind of cars can be divided into three types:

- Type A: One of the two high tension codes is exposed while the other one is hidden inside metal shielding (ILL. 4-26).
- Type B: Both of the high tension codes are exposed(ILL. 4-27), but the primary side lines are not available.
- Type C: No primary lines are available. One of the high tension cables is hidden.

c. For Type A, you can use the **primary trigger** may be used for a stable pattern display. Connect the probe with needle to the negative line of the primary ignition coil, and the probe without needle to the exposed high tension cable (ILL. 4-26).



ILL.4-26. DLI Double Ended Coil - Primary Trigger



ILL.4-27. DLI Double Ended Coil - Secondary Trigger

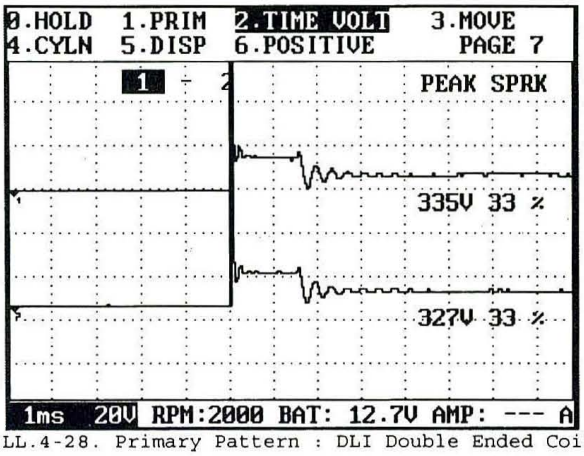
d. For Type B, you can select the secondary trigger itself as shown in ILL.4-27. Connect the clamp to one of the negative high tension cables (CH3). Attach the probe without needle to the other positive cable (CH2).

e. For Type C, a stable pattern display can not be obtained. Just connect the probe without needle to the high tension cable (CH2). One probe without needle will be used for both voltage induction and secondary trigger pickup. The pattern may be unstable.

Trigger Signal	Probe with needle	Probe without needle	Waveform output
Primary	CH1.Negative line of primary ignition coil	CH2. High tension cable to ignition plug	Primary and Secondary (stable)
Secondary	None	CH2. High tension Cable to ignition plug	Secondary only (Unstable)

2) Waveform Display

When all probe and cable connection have been properly made, an ignition waveform will be displayed as shown in ILL.4-28.



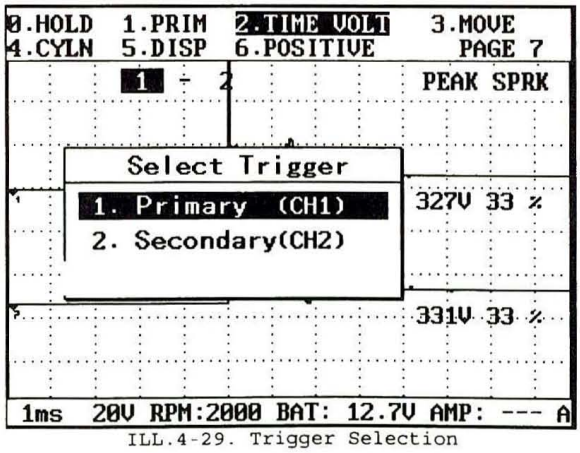
ILL.4-28. Primary Pattern : DLI Double Ended Coil

3) Secondary Pattern

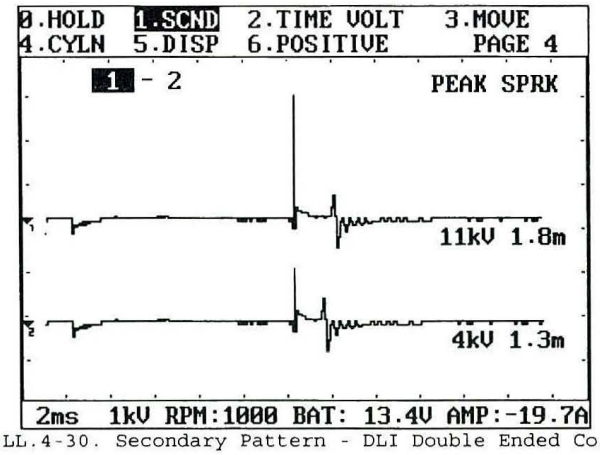
a. If the Secondary Trigger is selected, DCN PRO will display the Secondary Pattern without displaying the Primary Pattern. When you use the Primary Trigger, DCN PRO displays the Primary Trigger first. It is necessary to choose [1.PRIM] to change the mode to Secondary Pattern.

b. Trigger Selection

When you choose the secondary pattern from the above menu, trigger selection menu follows. Choose the trigger according to your cable connection.



ILL.4-29. Trigger Selection



ILL.4-30. Secondary Pattern - DLI Double Ended Coil

As shown in the illustration, DCN PRO displays two waveforms. This is because an ignition Coil of this type discharges both positive and negative electricity simultaneously to two spark plugs.

For 4-cylinder engines, there are two ignition coils and each coil is connected to two spark plugs. When one of the coils discharges positive electricity for example to cylinder #1, it also discharges negative electricity to cylinder #4 simultaneously. When the other coil discharges positive electricity to cylinder #3, it also discharges negative electricity to cylinder #2 simultaneously.

Therefore, there will be positive discharges in cylinder #1 and #4, and negative discharges in cylinder #3 and #2 at the same time. Will this cause cylinder #1 and #4 to fire together? No. When one cylinder is in combustion stroke, the other will be either in the exhaust, intake or compression stroke. Since the mixture in the other cylinders is not dense enough to properly combust, it burns but does not fully combust.

From the two cylinders that ignite together, the waveform of the valid electricity discharge that creates combustion is called 'True Waveform', and the other that ignites but does not fully combust is called 'Waste Waveform'.

The density of mixtures in the cylinders that are in the strokes other than combustion stroke are below combustible level. The higher the resistance level, the higher the voltage is required to bridge the ignition gap. This means that the peak voltage of the TRUE waveform is higher than that of the WASTE waveform. Between the two waveforms, TRUE waveform can be distinguished from the WASTE form in this manner. In ILL. 43, the second waveform is TRUE.

4) Display Control Functions

a. NEGATIVE / POSITIVE

Selects the discharge polarity of spark ignition

- ○ When the selected polarity differs from vehicle's actual discharge polarity: the waveform may be displayed upside down or the waveform may not be displayed at all
- The polarity switches between Positive and Negative when the [5] key is pressed

b. All other functions do the same as previously explained. Refer to the distributor vehicle part.

5. Print Output

Refer to Chapter 3. Oscilloscope, Part 4. Print Output.

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